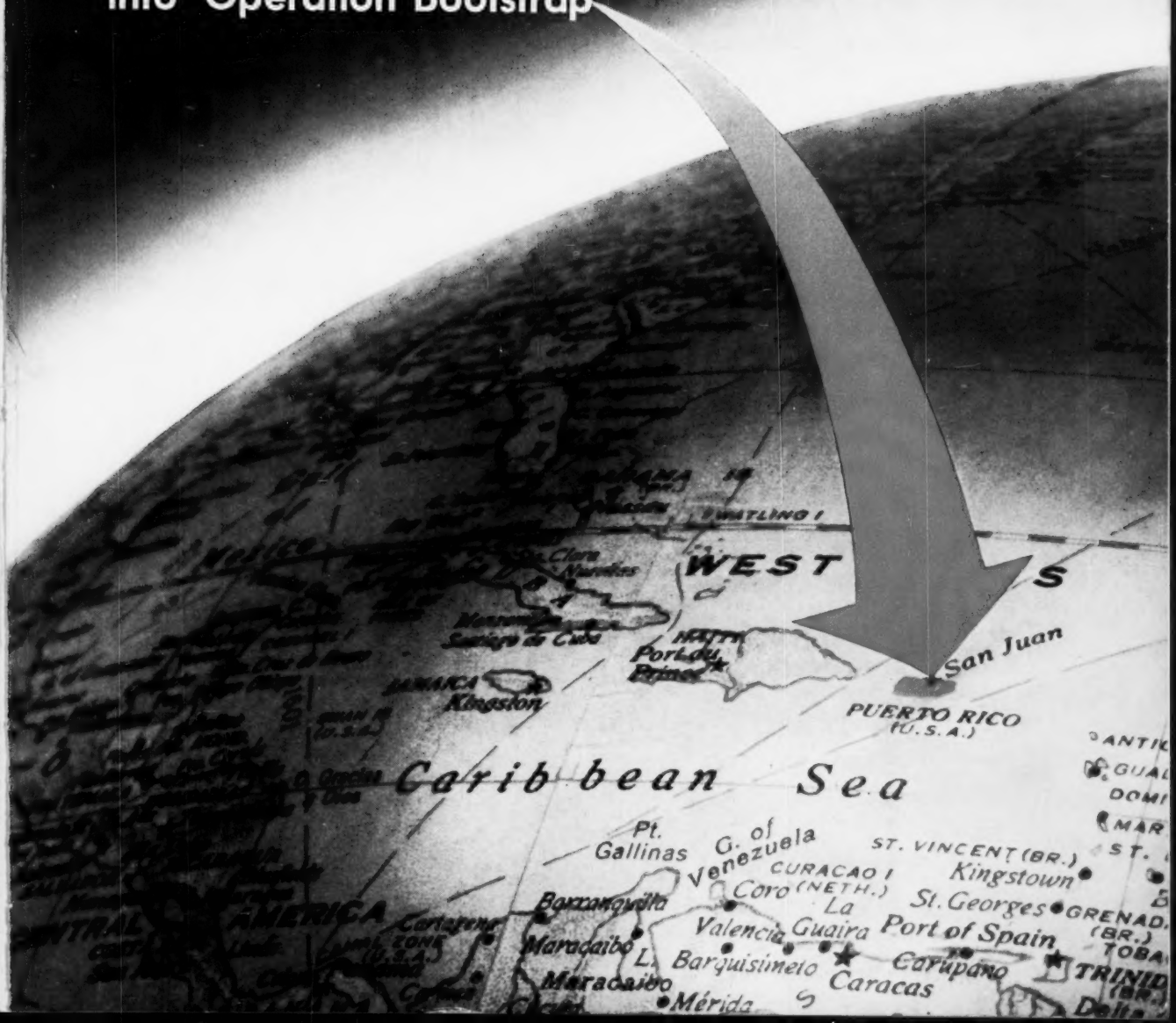
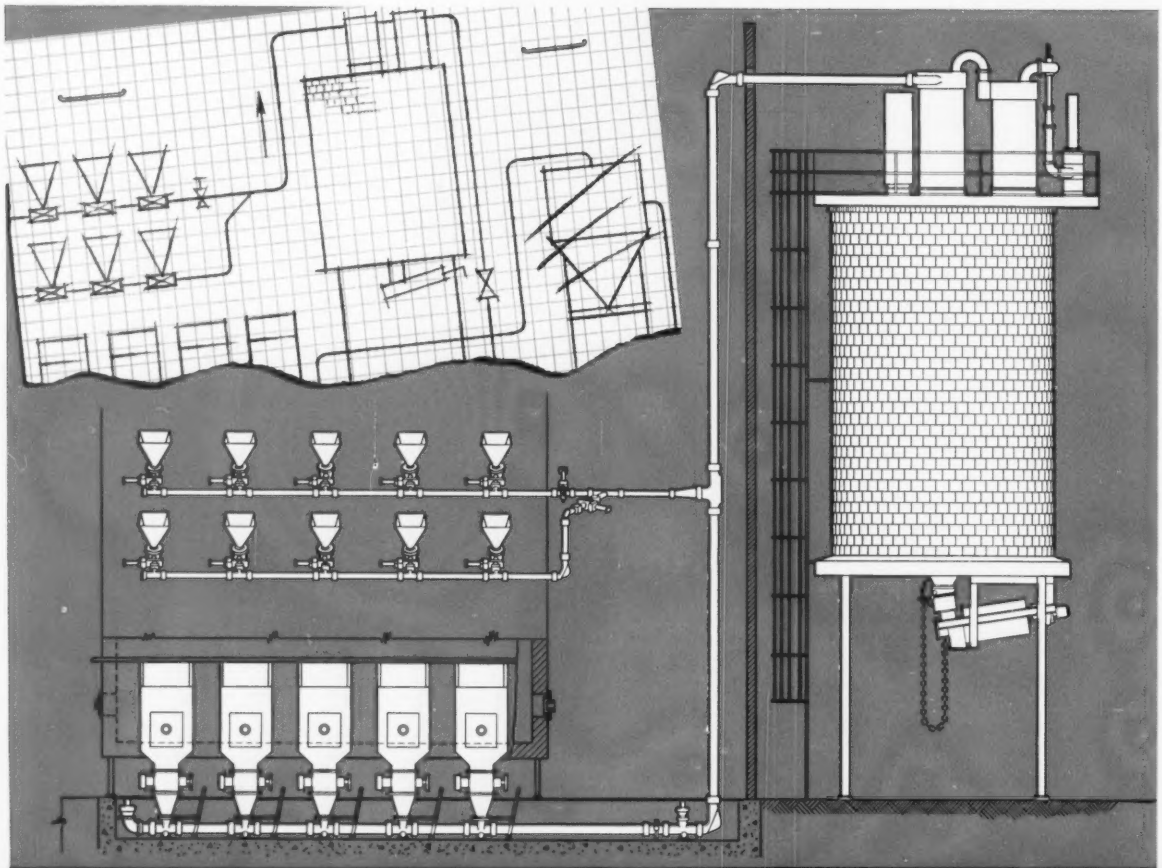
75th Year Building a more powerful America

Power

MARCH 1957
ONE DOLLAR
A McGRAW-HILL PUBLICATION

Power growth puts the muscle into 'Operation Bootstrap'





Let A-S-H help with your ash handling problem

FROM FIRST-STAGE DISCUSSION TO FINAL SOLUTION *

What type ash handling system's *just right* for your plant?

A dry system using a steam jet exhauster or blower, discharging to silo or fill area? A wet system with centrifugal type or jet type pump, discharging to bin, fill area, or sump? A combination system—pneumatic for flyash, hydraulic for bottom ash? Or some other?

A-S-H has *project engineered* ash handling systems of every type for power plants throughout the world. In helping plan these installations, in making available many years of specialized experience, A-S-H engineers have helped save the power and engineering companies concerned considerable time and money.

A-S-H can and will help you solve knotty handling problems during every stage of development from initial planning through prompt servicing. Where feasible, A-S-H standard equipment is specified. Where conditions dictate, A-S-H never hesitates to redesign, modify—*even invent*—components to provide the best possible problem solution.

Solving ash handling problems is a big part of our business. There are none too small, none too big for us to tackle. We're interested in *your* job, be it a simple system for a small boiler plant (like the one shown above) or a new concept never before tried.

Acquaint us with your requirements. Ask us for helpful data or for our field engineer to call. You'll get *prompt* attention.

* *A-S-H service doesn't stop with installation. When service problems come up, we stand ready to give prompt service assistance. This is a policy worth considering when suppliers are being selected.*

MATERIALS HANDLING SYSTEMS

"Hydrojet" *hydraulic*

"Hydrovac" *pneumatic*

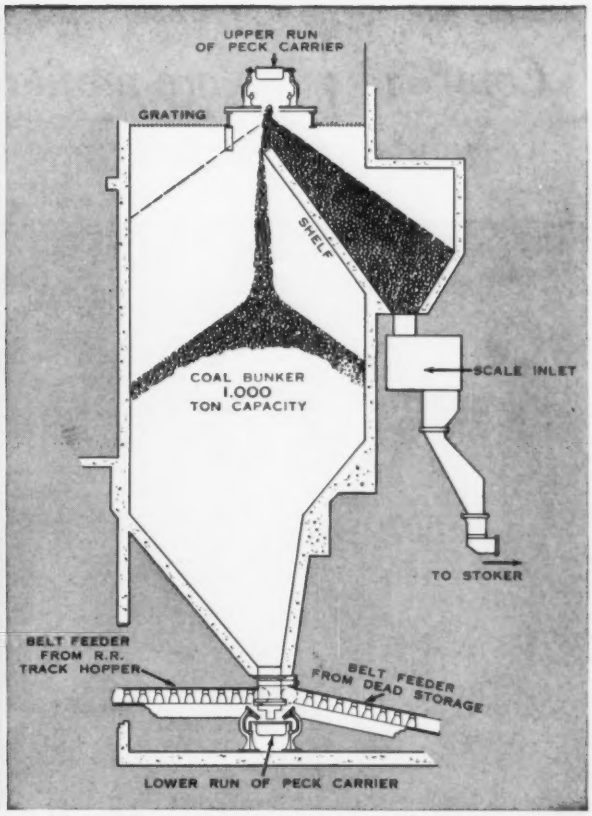
A-S-H

the **Allen-Sherman-Hoff** company

259 E. Lancaster Ave., Wynnewood, Pa.

Offices and representatives in principal cities

PRUDENTIAL BUILDING is the latest of several Chicago landmarks to use Link-Belt coal handling. Naess & Murphy, Chicago, served as architects and engineers. Others: Merchandise Mart, Tribune Tower, Conrad Hilton Hotel, Wrigley Building, Palmer House, Board of Trade Building, Chicago Natural History Museum.



PECK CARRIER travels rectangular path. Coal is loaded along lower run under active storage bunkers . . . elevated vertically . . . carried along top of bunkers and automatically discharged by movable dumper. H. P. Reger Co., Chicago, was heating contractor; George A. Fuller Co., Chicago, was general contractor.

At the Prudential Building—Chicago's newest and tallest skyscraper—it's

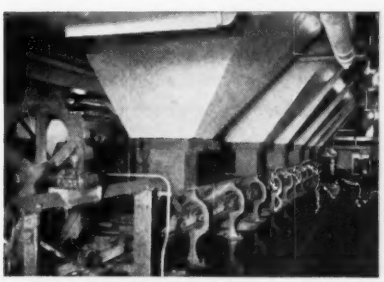
LINK-BELT coal handling equipment

A Link-Belt Peck Carrier and belt feeder help the $40-million Prudential Building match its modern accommodations with equally efficient coal handling. The carrier has pivoted buckets suspended in a way that keeps them upright while travelling either horizontally or vertically. Coal can be handled in a continuous flow without necessity for transfer points.

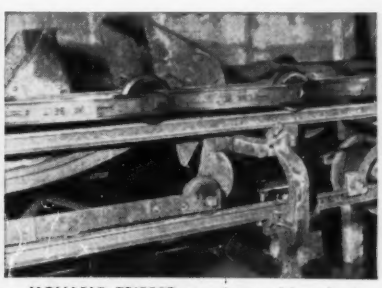
Such specialized equipment—part of a complete line—and engineering background unexcelled in the field make Link-Belt a leading source for all coal handling needs. We will gladly work with your consultants. Call your nearest Link-Belt office, or write for Book 2410.

LINK-BELT

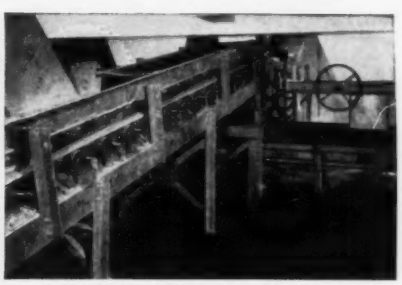
COAL HANDLING EQUIPMENT



RACK AND PINION GATES on bunkers along lower run permit coal to be recirculated back into Peck Carrier.



MOVABLE TRIPPER can be positioned at any spot along horizontal runs of carrier, allowing pin-point discharge.



BELT FEEDER handles coal from dead storage bin to Peck Carrier. Another brings incoming coal from track hopper.

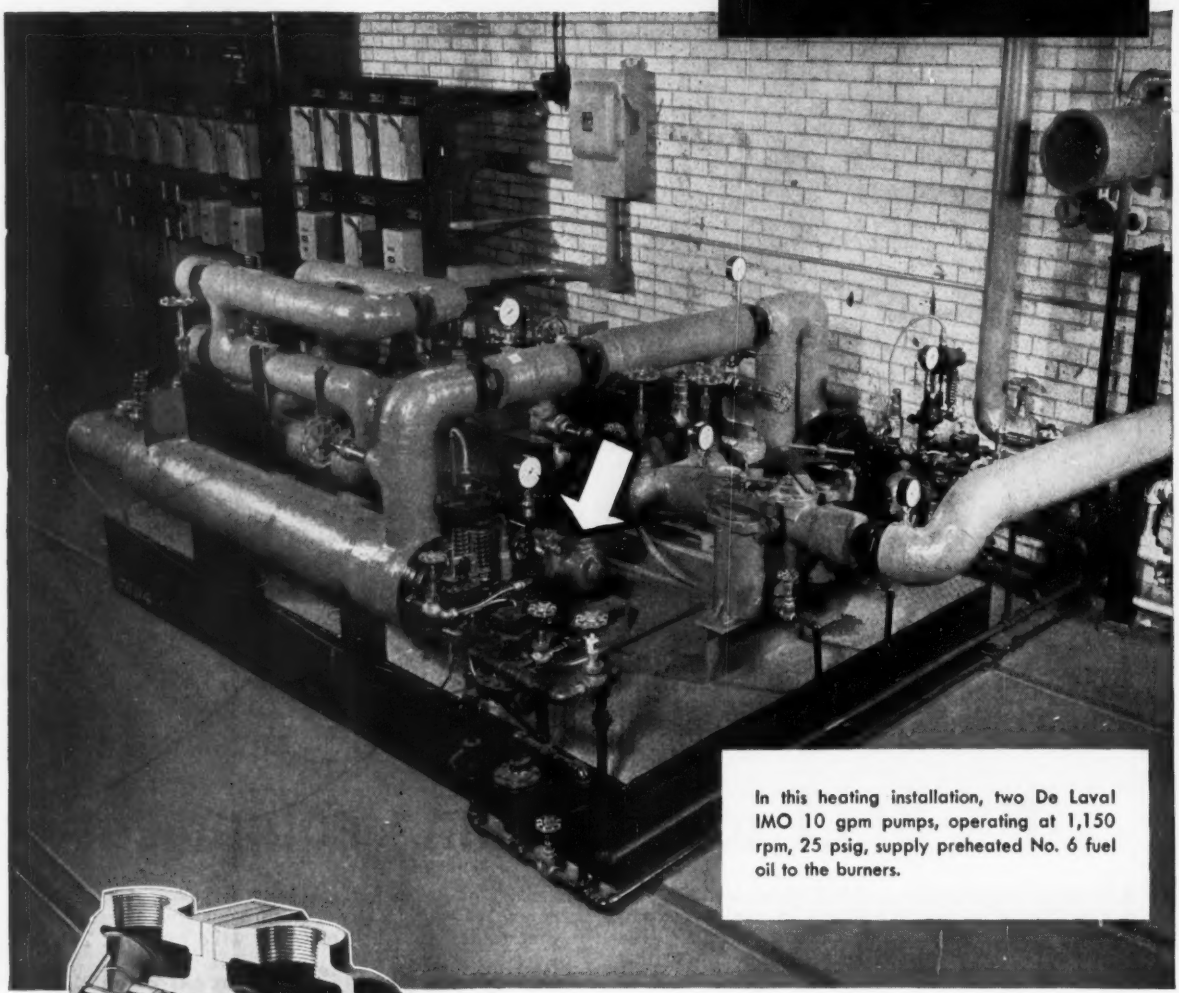
14,223

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

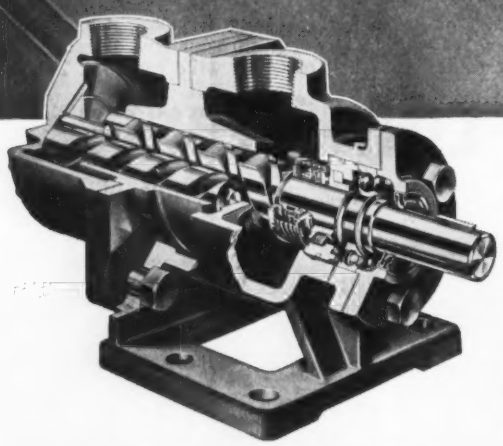
Contracts are more profitable when you install dependable

DE LAVAL

IMO PUMPS



In this heating installation, two De Laval IMO 10 gpm pumps, operating at 1,150 rpm, 25 psig, supply preheated No. 6 fuel oil to the burners.



A wide range of De Laval IMO models specifically built for fuel oil service is available. Capacities up to 80 gpm, pressures to 275 psig. Write today for Bulletin LG-A.

To increase your present—and future—profits on commercial heating jobs, install *dependable* De Laval IMO pumps on pump and heater sets. Their simple, trouble-free design saves you money on service calls. . . builds customer goodwill, for there's nothing to get out of order or need adjustment. No pilot gears, no sliding vanes, no reciprocating pistons. De Laval IMO's have only three moving parts—smoothly intermeshing rotors that propel the fluid axially in a steady flow without churning, pocketing or pulsation.

DE LAVAL *IMO Pumps*

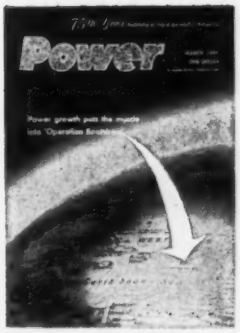
DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL27B

Power

MARCH 1957 • VOLUME 101 NUMBER 3



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Print order this issue: 48,770

PUERTO RICO'S "Operation Bootstrap" so piqued POWER editors' interest that they voted it this month's cover spot. Story appears on p 75. Sobered by dwindling resources and growing population, this tiny West Indian Isle has pulled up its socks and gone to work. Its success in recruiting and providing power for new industries may pave the way for other hard-pressed countries.

Next month . . .

Automatic data logging coupled with a power plant scanning system chalks up a first that may mark the beginnings of a new era in controls. It's designed to make more efficient use of manpower, boost system efficiency, reliability, safety—and results are beginning to show. Read how these systems work; why they may mean basic changes in plant operating methods.

Electric heating, as a design problem, starts with calculating the wattage needed, then selecting the most suitable equipment to do the job. Forthcoming article shows steps in calculating total wattages whether you want to melt material, vaporize a liquid or merely heat a substance.

Water treatment for diesel-engine cooling systems is often neglected. In April issue, check methods of cleaning a cooling system. Then learn how to prevent future scale and corrosion.

. . . and a future month

Don't overlook the simple belt and chain as a prime link in transmitting power mechanically. May report, which covers new designs and current uses, will give you new perspective.

March 1957 POWER Vol. 101—No. 3

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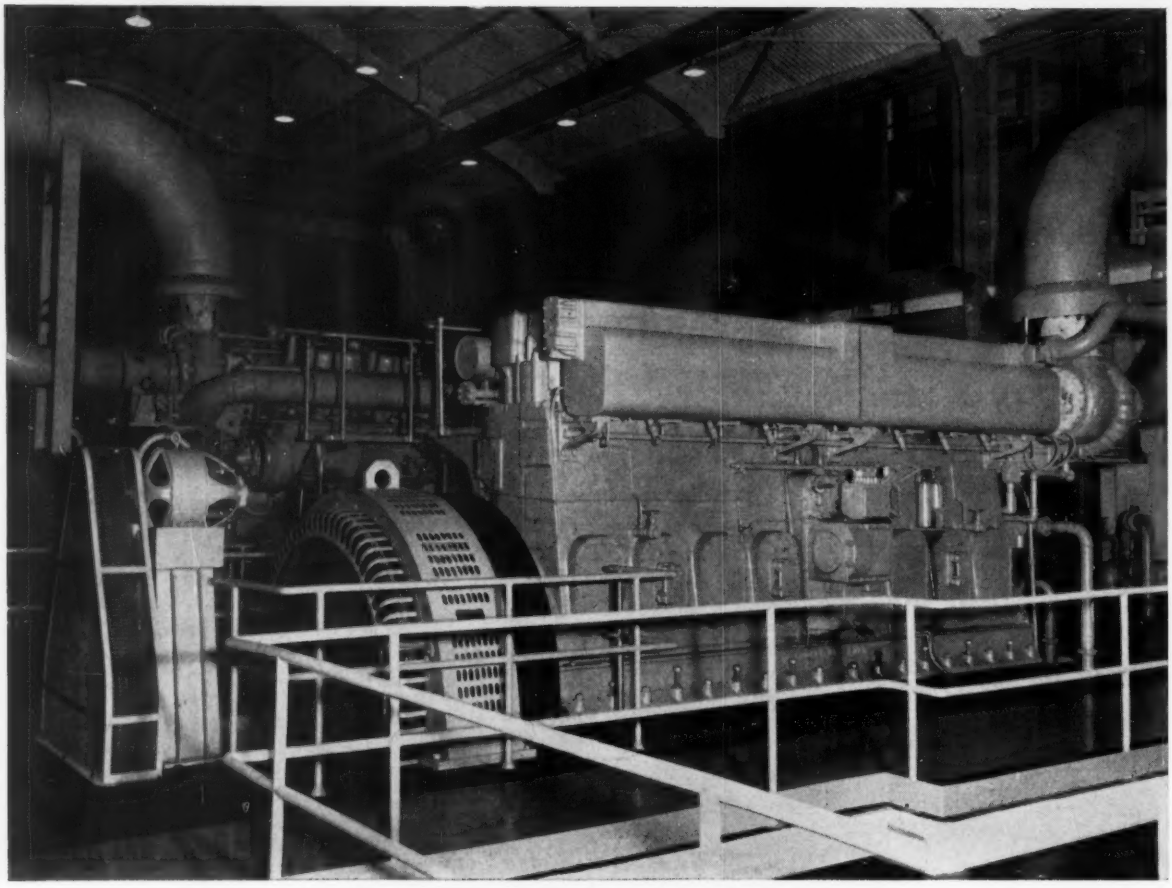
POWER PLANT OPERATORS REPORT:



MORE POWER

FROM TEXACO-LUBRICATED ENGINES

According to actual case history reports, power plant engines show a power performance improvement when lubricated with *Texaco Ursa Oils*. This is because *Texaco Ursa Oils* 1) help keep rings free for full-power compression and complete combustion, 2) resist oxidation and sludging, 3) prevent harmful deposits, 4) reduce wear.

There is a complete line of *Texaco Ursa Oils*, designed and processed especially to make diesel, gas, and dual-fuel engines deliver *more power* with *less fuel* and *longer periods* between overhauls.

For over 20 years, more stationary diesel horsepower in the U. S. has been lubricated with Texaco than with any other brand.

Your Texaco Lubrication Engineer will give you full information. Just call the nearest of more than 2,000 Texaco Distributing Plants in the 48 States or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO **TEXACO URSA OILS**
FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

TUNE IN . . . METROPOLITAN OPERA RADIO BROADCASTS EVERY SATURDAY AFTERNOON

speaking of **Power**

Getting the power story on 'Operation Bootstrap'

Ah, warmth, travel... but not too warm... nor frantic cabbies

Hospitality galore... then back to New York

While New York was gripped by snow-whipped 24-deg weather a few weeks back, Associate Editor Ben Skrotzki was enjoying the mild-Turkish-bath climate in Puerto Rico. His two-part assignment: (1) Get the facts on how PR is meeting increased power demands. (2) What plans are being laid for tomorrow in the face of "Operation Bootstrap"?

Ben arrived at his destination, the Caribe Hilton Hotel in San Juan, after a memorable 6-mile cab ride from PR's International Airport. His impression of this ride was that PR's cabbies must be temperamentally related to their carefree Mexican counterparts.

In the patio of the Caribe Hilton, Ben was greeted by the unofficial, but thoroughly democratic welcoming committee—six well-trained flamingos. And away-from-home niceties were not overlooked. In the best tradition of PR innkeepers, Ben received a presegmented pineapple, resplendent in its natural sheath.

Throughout Puerto Rico, Ben found modern air-conditioned structures in sharp contrast to many old-world surroundings. He noted that most industrial growth has been with light industry, drawing on women rather than men for production workers. However, the PR Economic Development Administration is welcoming heavy industry as potential users of more male workers.

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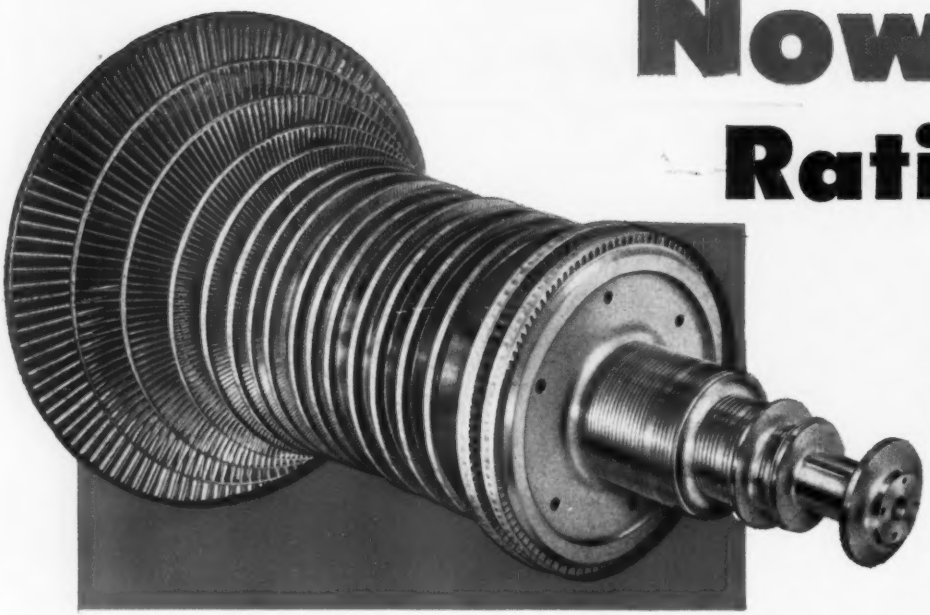
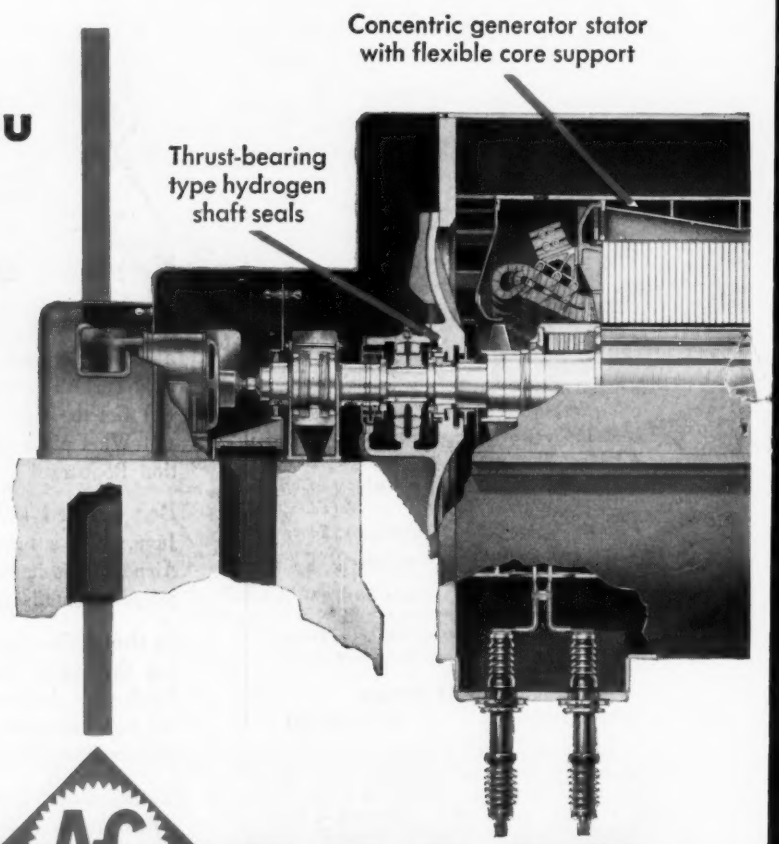
Now in Ratings



Here is the turbine rotor for one of the 16,500-kw units now being built. For this 850-psig, 900-F AIEE-ASME turbine, rotor shaft and wheels are of integrally forged construction.

Allis-Chalmers Turbines Give You MORE Modern Design Features



CUTAWAY VIEW of 16,500-kw unit shows the development of impulse turbine design for larger ratings.

A-C ALLIS-CHALMERS

ALLIS-

Production up to 16,500 Kw

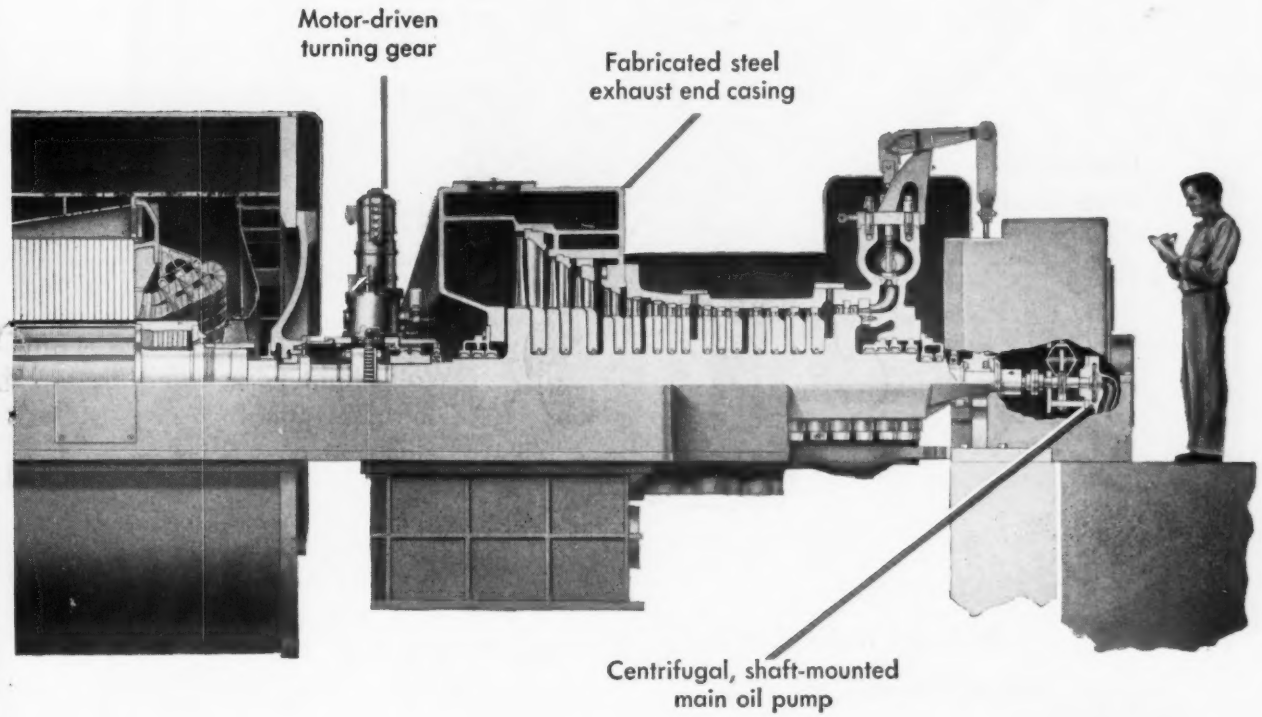
NEW Large WA-Series Turbines Offer

Advanced Design Features • **Simplified Installation** • **AIEE-ASME and NEMA Ratings**

NEW WA-Series steam turbine-generator units now being manufactured include the 10,000-kw NEMA standard rating as well as 12,650-kw and 16,500-kw AIEE-ASME preferred standard condensing ratings. The 16,500-kw units have hydrogen-cooled generators.

Incorporated in the design are time-proved labyrinth steam sealing, removable external glands, high chrome alloy steel buckets and nozzles, reliable governing system, and unit shipment and installation — plus additional large turbine and generator features.

To get MORE information on economical, dependable units 2000 kw and larger, call the nearest A-C district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

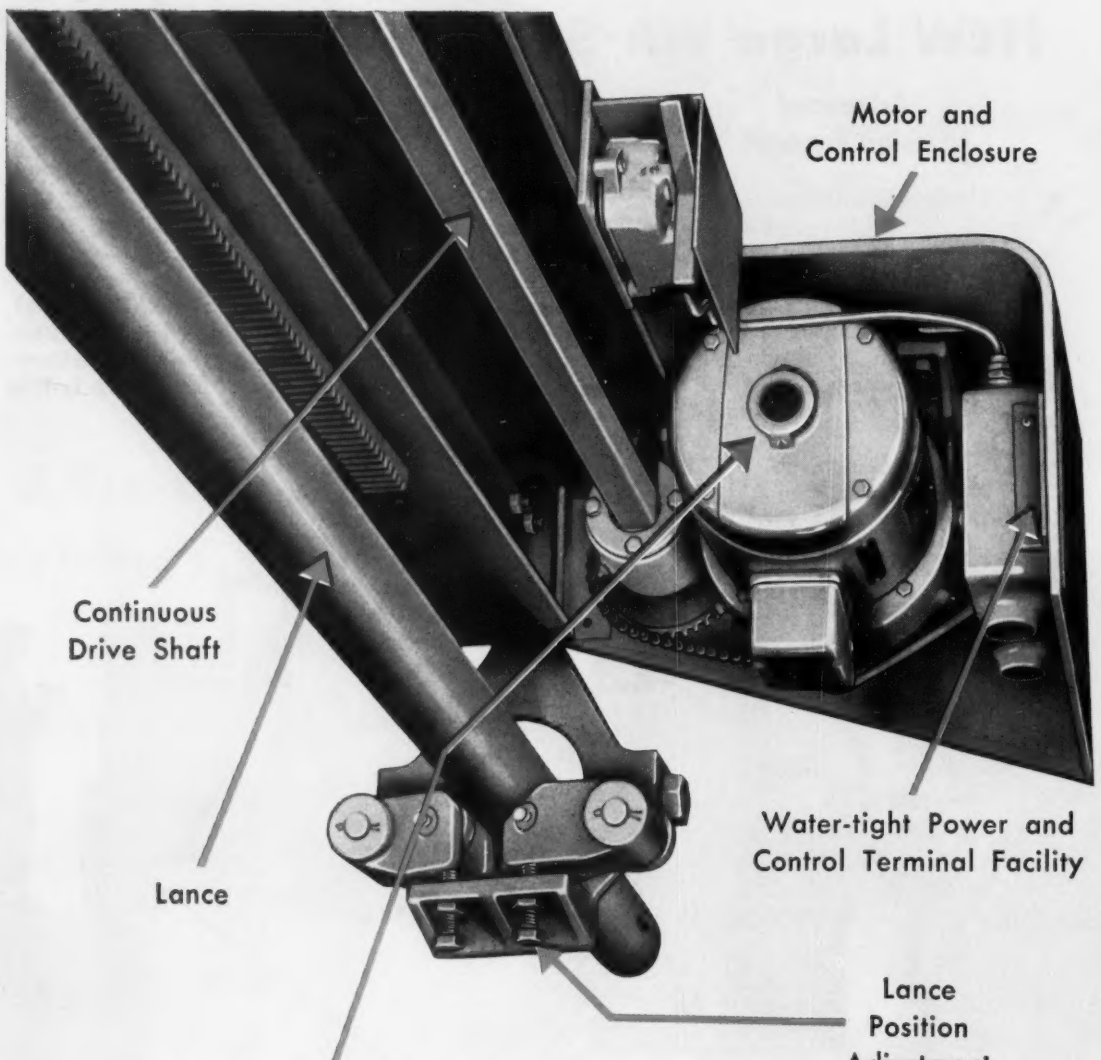


CHALMERS

LIVE BETTER ELECTRICALLY

A-5127

FRONT END



Single Enclosed Motor for both
propulsion and rotation
Motor mounted at boiler end for improved
accessibility and better protection from
physical damage and elements.
(Outboard end motor mounting optional)

Single-Motor DRIVE

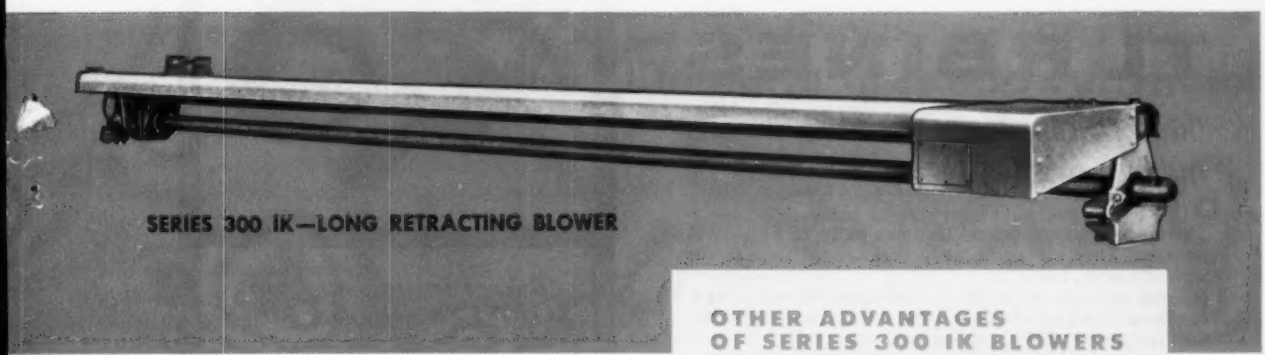
another important feature of

New Diamond

Series 300 IK
LONG RETRACTING BLOWER

As illustrated at the left, only *one motor* is used to simultaneously propel and rotate the lance tube of the new Series 300 IK. The motor is stationary and is mounted at the boiler wall for easier accessibility and greater protection from physical damage and the elements (note the protective enclosure). This front end single-motor drive is simple and dependable. There is only *one* set of motor elements . . . *one* set of control elements . . . and *one* set of power supply facilities to operate and maintain.

Additional important features of the new Series 300 IK are listed in the panel below. Check them and you will understand why this blower is establishing a new standard of efficiency, economy and dependability in cleaning those heating surfaces that require a long retracting blower. For further information about the new Series 300 IK, ask your local Diamond office or write directly to Lancaster for Bulletin 2111. U.



SERIES 300 IK—LONG RETRACTING BLOWER

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Compact, Accessible Electric Power and Control Terminal Facilities
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

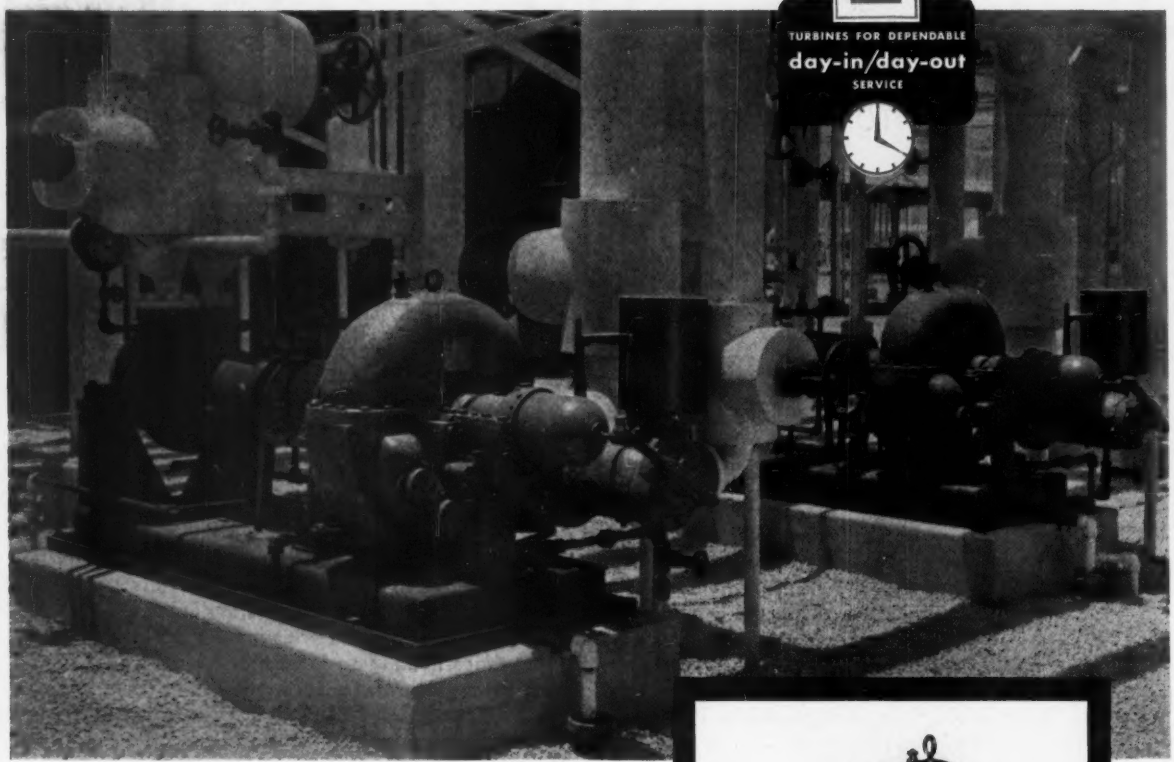
Diamond **DIAMOND POWER SPECIALTY CORPORATION**

LANCASTER, OHIO

Diamond Specialty Limited

Windsor, Ontario

7739



ELLIOTT YR TURBINES

the best anywhere...serving process industries everywhere

There's no mystery behind the popularity of Elliott YR turbines. They are deliberately designed to provide the highest quality, long-term continuous service. Turbine components are made of the finest materials, built in quantity to close tolerances and rigid specifications. Assembly is carefully controlled to meet the required—and in fact the most rugged—operating conditions. Easy inspection, accessibility of wearing parts and interchangeable components are additional advantages.

That's why thousands of Elliott mechanical drive turbines are in use all over the country—like the two above, driving a natural gas plant pump in West Texas. For Bulletin H-22B which describes the designing features, call your local Elliott field engineer or write Elliott Company, Steam Turbine Division, Jeannette, Pa.

6 design features you get with ELLIOTT YR single-stage turbines

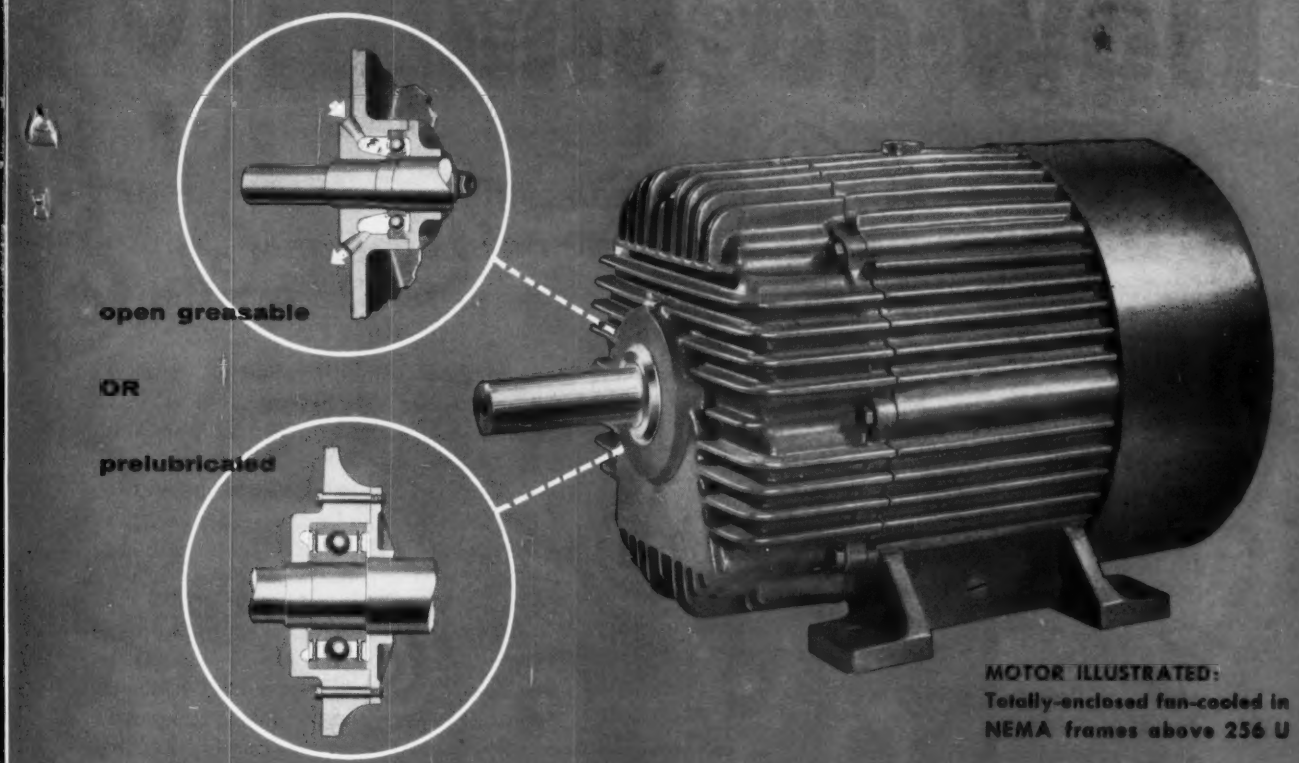
- True Centerline Support for precise alignment, cold or hot, simplifies installation.
- Weather-Proofed, Reliable Governing System with separate overspeed trip and valve.
- Liner Type Bearings, easy to inspect or replace, rapid heat transfer to cooling oil, sealed against elements.
- Accessible Shaft Seals. Covers—not part of turbine casing—are easily removed for inspection or ring replacement.
- Self-Locating Rotor drops into position without adjustments. Entire rotor is dynamically balanced.
- Interchangeable Components permit interchanging of parts between turbine frame sizes, eliminates need for large inventories.

H7-2

ELLIOTT Company

Steam Turbines • Motors • Generators • Deaerating Heaters • Ejectors • Condensers • Centrifugal Compressors • Turbochargers • Tube Cleaners • Strainers

YOUR CHOICE of motor bearings . . .



MOTOR ILLUSTRATED:
Totally-enclosed fan-cooled in NEMA frames above 256 U

—when you specify ELLIOTT Crocker-Wheeler Type N integral horsepower motors

Whatever your operating conditions or maintenance practice, Crocker-Wheeler offers the motor bearing best adapted to your needs or preference.

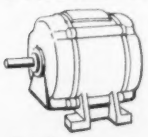
The Open Greasable type
requires only infrequent lubrication. All old grease is positively flushed out, eliminating risk of forcing grease into motor interior. An external grease reservoir helps seal and protect the bearing. The inner cap and grease reservoir prevent rust or corrosion from within.

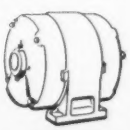
Prelubricated bearings
are furnished for applications requiring operation without regular service lubrication. They are sealed cartridge-type, factory grease-filled, with inner protective cap.

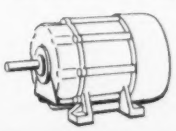
Choice of bearings
is another design feature of the new Elliott Type N motor line. These motors are honestly new—inside and out. We think you'll agree that they incorporate every important feature that distinguishes a modern motor.

W7-1

OTHER C-W TYPE N MOTOR ENCLOSURES


Totally-enclosed non-ventilated

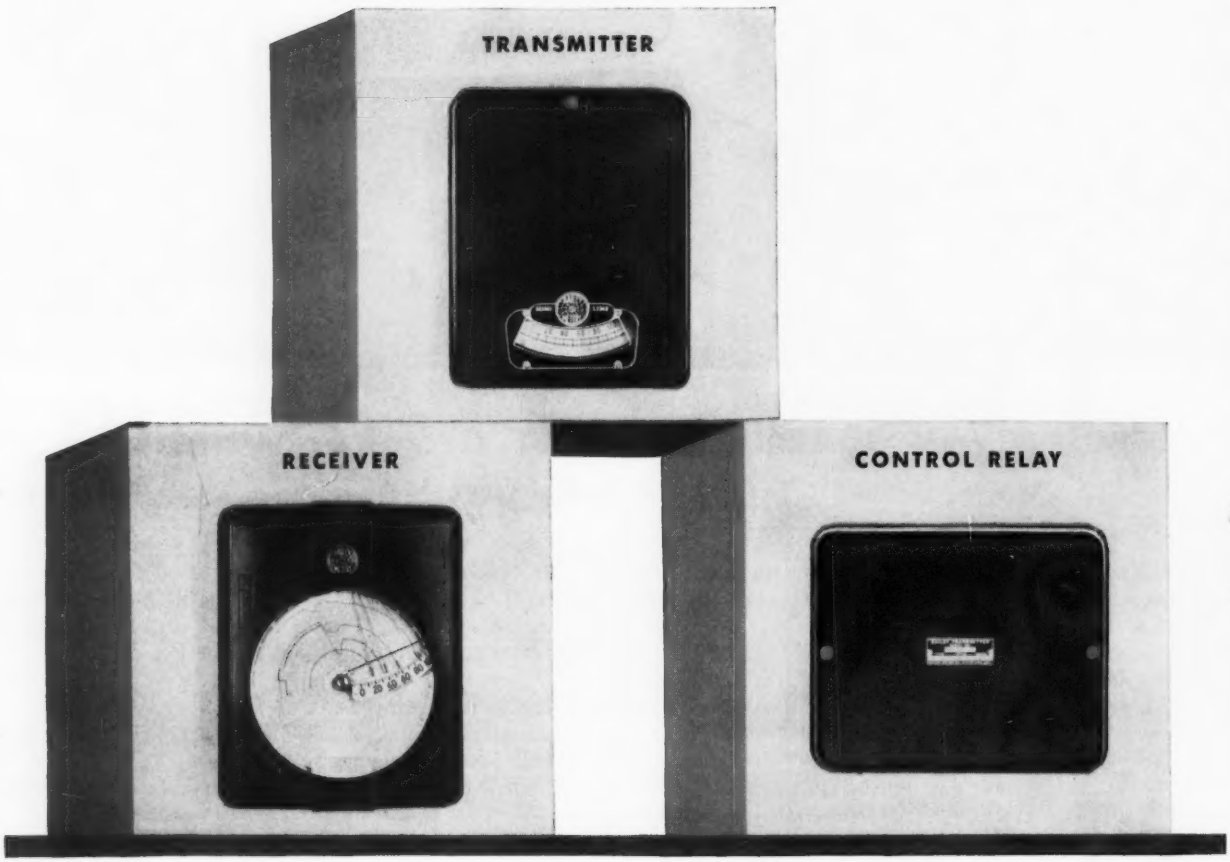

Dripproof Protected


Totally-enclosed, fan-cooled Frames 256 U and smaller

ELLIOTT Company
CROCKER-WHEELER DIVISION
Jeannette, Pennsylvania

We will be glad to send a copy of this new booklet describing the complete line of Elliott C-W type N motors. Ask for Bulletin PB 6000-6.

How to simplify



The Bailey Building Block Method enables you to simplify control problems by combining standardized measuring, transmitting, and controlling components as required.

control problems

Keep systems flexible, carry small inventory, cut maintenance cost with the **Bailey Building Block Method** of instrumentation and control.

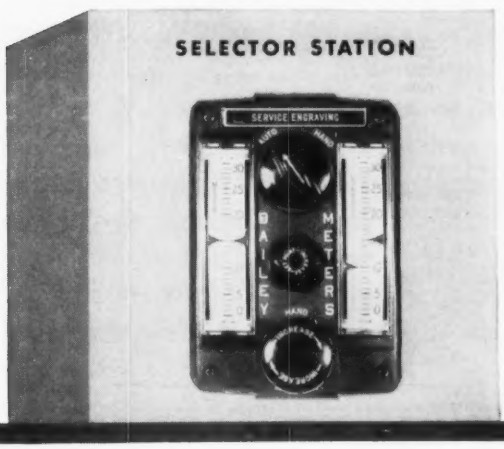
What is the Bailey Building Block Method? It's using standardized Bailey measuring, transmitting, and controlling components and combining them into any system you need. Components can be added as needed . . . removed and reused elsewhere . . . recombined into another system when the need changes. It's flexibility plus!

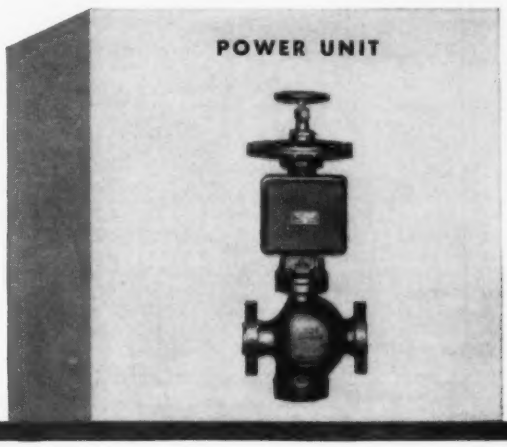
It's all based on the simple fact that a Bailey instrument or control component doesn't care if the measured variable is steam flow, tank level, or heater temperature, to pick just three examples. System components—transmitters, receivers, relays, selector stations, power units—are standardized for multi-purpose use.

A spare component can be used in any one of many systems. Gone are delays waiting for shipments of special parts. Gone are large inventories of spares and parts. Simplified is the training of men for maintenance.

There are many exclusive features and advantages of the individual components used in the Bailey Building Block Method. And there's much more to the Building Block story itself.

For further details, call our local district office or write us at Cleveland. Our engineers will be glad to prove how the Building Block approach will save you money and simplify your instrument and control problems.



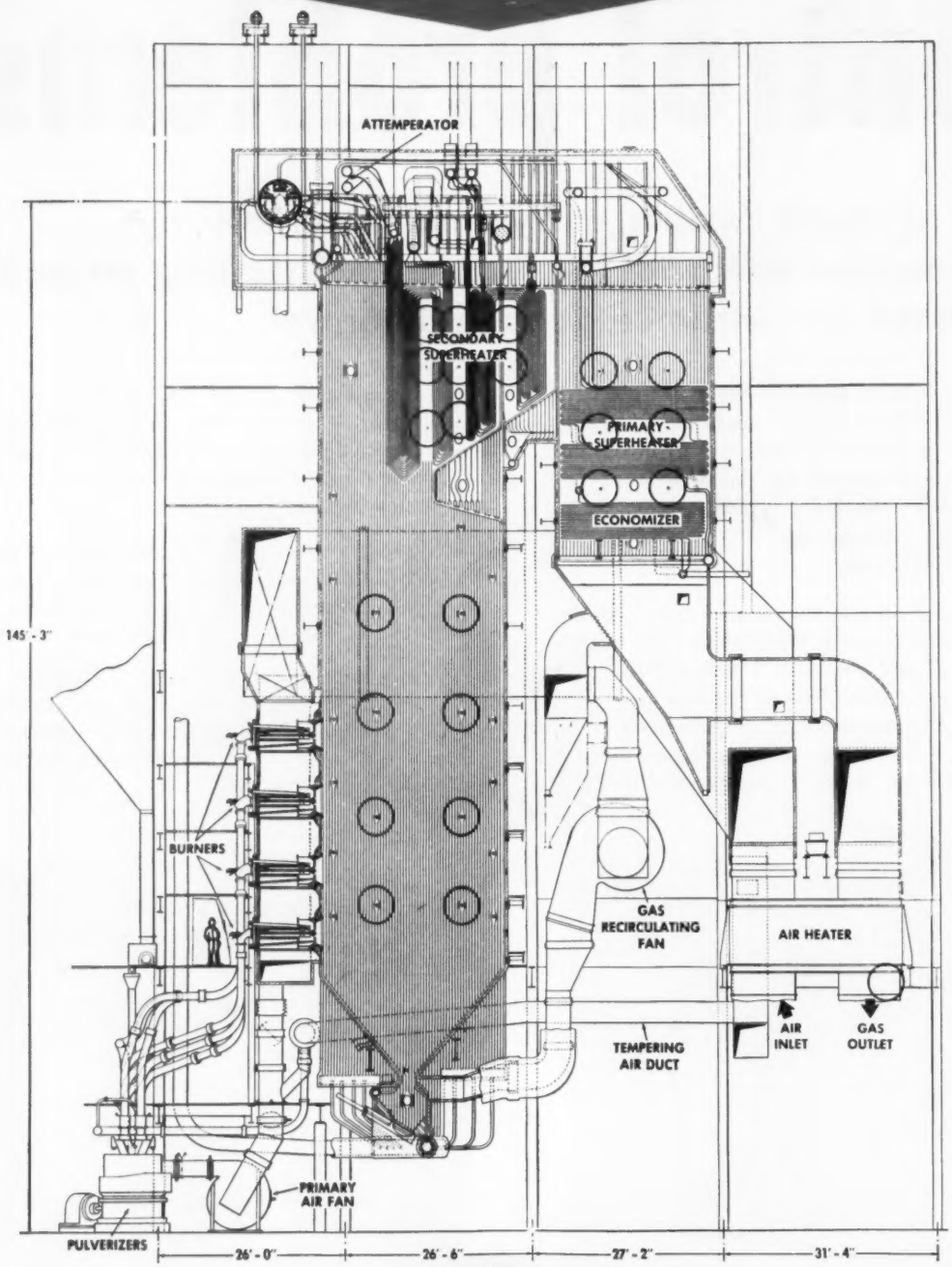


G36-2

BAILEY BUILDING BLOCK METHOD

BAILEY METER COMPANY
1036 IVANHOE ROAD, CLEVELAND 10, OHIO
In Canada—Bailey Meter Company Limited, Montreal

RESULTS IN: FLEXIBILITY, SIMPLICITY, ECONOMY



CONSOLIDATED EDISON COMPANY

ASTORIA GENERATING STATION, NEW YORK, NEW YORK

BABCOCK & WILCOX TWIN-FURNACE BOILER

2—40'-0" FURNACES

C-3400

Capacity, Lb. Steam per Hour . . . 2,400,000
Design Pressure, PSI 2,500
Fuel . . . . . pulverized coal, oil or gas
Reheat Steam Temperature, F 1,000
Superheater Outlet Pressure, PSI 2,150
High-Pressure Steam Temperature, F . . 1,050
Pressurized Furnace

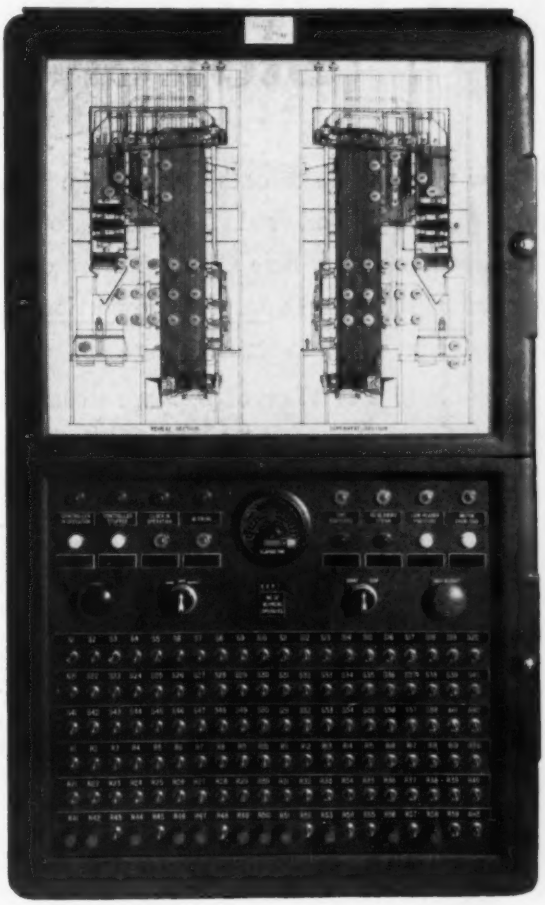
Another Vulcan Selective-Sequence for Consolidated Edison!

Con-Edison specifies Vulcan Selective-Sequence Soot Blowing for Arthur Kill Station

The 2,400,000 pph boiler planned for the Arthur Kill Station, Staten Island, is an exact duplicate of the boiler at Astoria Station. As at Astoria, each of the two forty-foot furnaces will be equipped with an all-electric custom designed Vulcan system.

Drive for the soot blower systems will be electric; the blowing medium steam. Each wall deslagger and long retractable soot blower has a direct-acting Type D head, and a pressurized seal and aspirator for the pressurized furnace. Wall boxes for the long retracts combine scraper and seal. This novel arrangement simplifies sealing off boiler gases from the soot blowers, and assures complete protection.

Whether your boiler is large or small, power or process—a modern Vulcan Soot Blower System with automatic-sequential or selective-sequence control will keep it operating at peak efficiency. Your Copes-Vulcan representative has the ideas, information and experience to help you choose the system best suited to your needs.



NERVE CENTER of the Selective-Sequence system consists of two completely pre-wired, factory-assembled controllers—one for the soot blowers in each furnace. Selective-Sequence lets operating personnel select the proper blowing sequence for most effective boiler cleaning. Since each soot blower is separately monitored, the operator can tell at a glance which blowers are operating, time elapsed, number of blowers that have operated and the location of any malfunction of equipment or blowing medium.

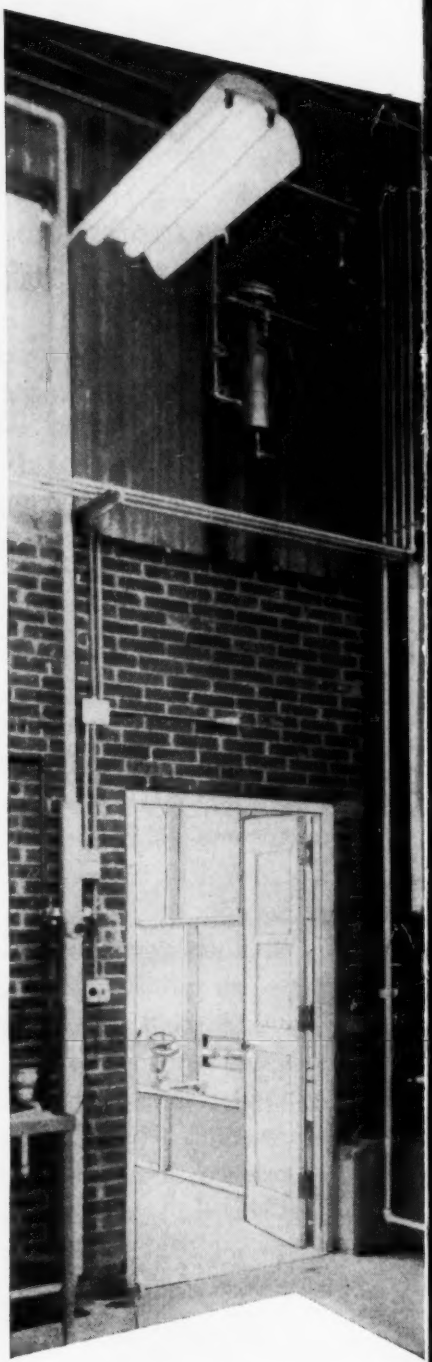
COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA

ERIE CITY

For Future... Stoker Firing

• Now it's possible to obtain the advantages of completely packaged gas and oil fired steam generators and still provide for future stoker firing. Erie City VL's are designed as a true package with furnaces properly proportioned and arranged for easy conversion to stoker firing.

These Erie City VL type package steam generators are arranged for either forced or induced draft operation and are shipped shop assembled with brickwork installed. Controls and Burners are piped, wired and mounted — and remember — Erie City package boilers are Factory Fire Tested prior to shipment. All this ready for your basic service connections plus having a boiler designed for the future installation of an Erie City stoker. Write for Catalog SB-432c.



2 Additional Units Now Installed

• *When American Synthetic Rubber Corporation of Louisville, Kentucky modernized its steam facilities, they turned to Erie City Packaged Power. Installed there are three 25,000 pounds per hour VL type packaged steam generators complete with Erie City steam atomizing combination gas and oil burners and arranged for the future installation of Erie City Underfeed Stokers.*

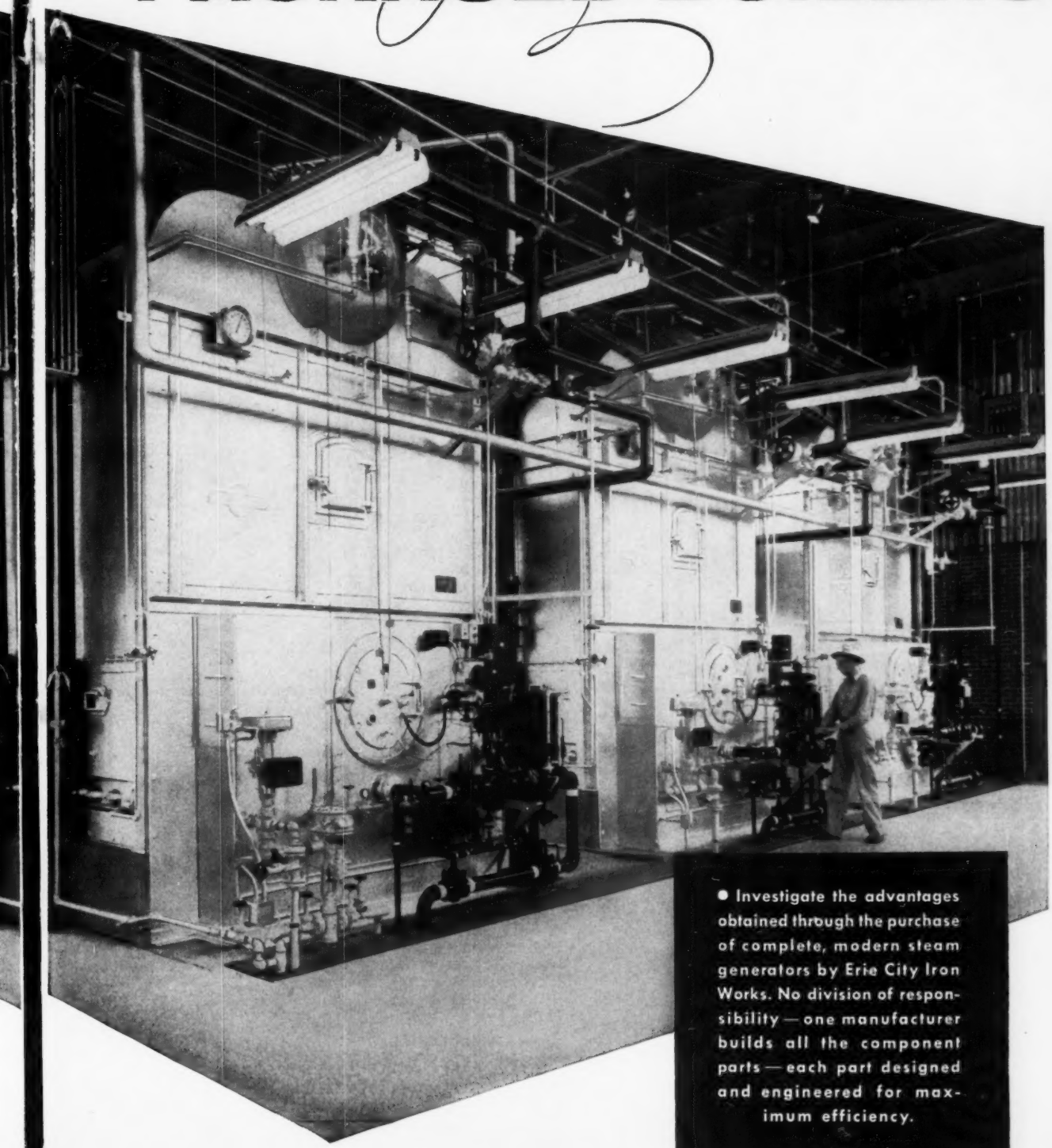
ERIE CITY
117 Years in Steam Generation

You can depend on Erie City for sound engineering

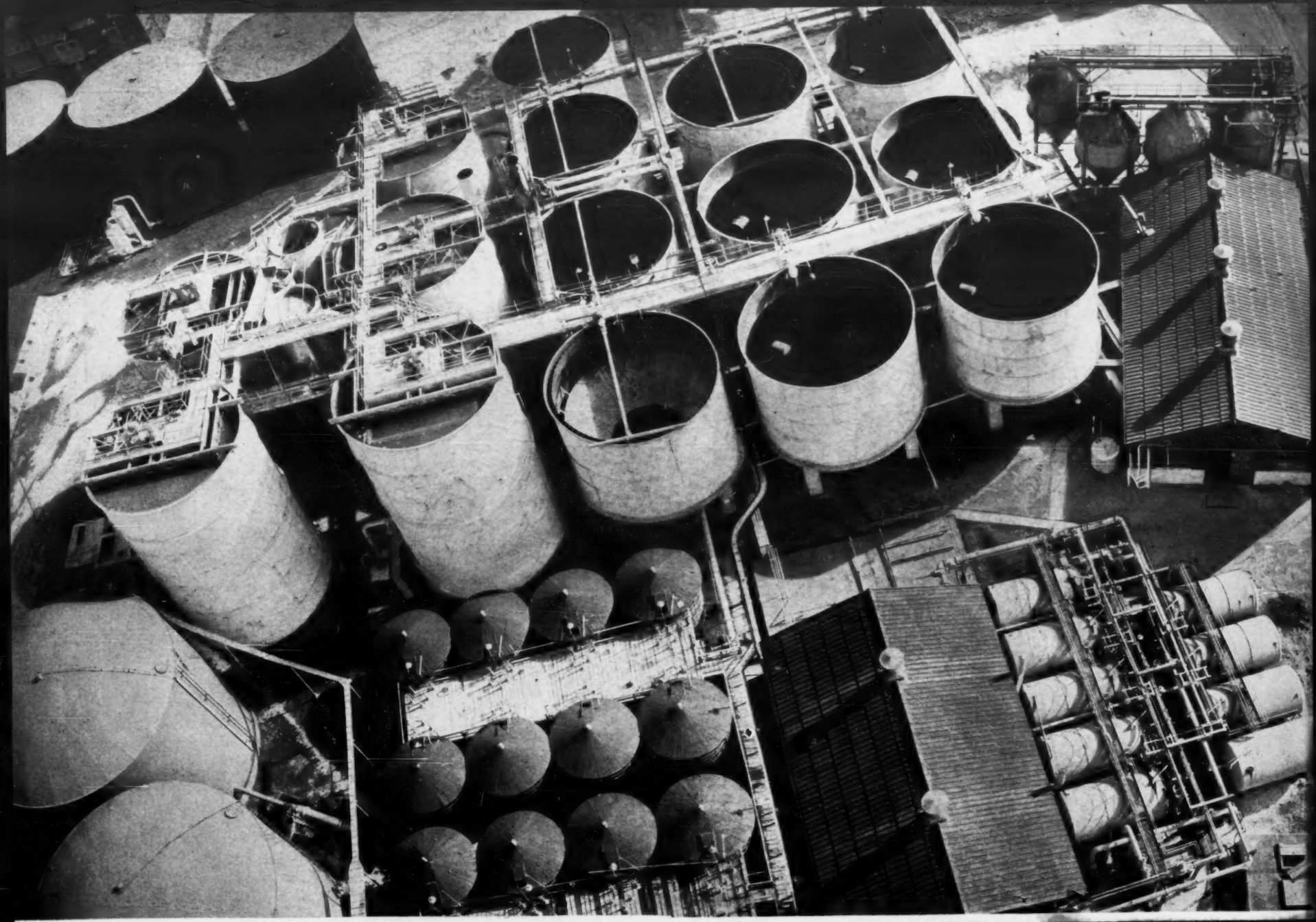
ERIE CITY IRON WORKS • *Erie, Pa.*

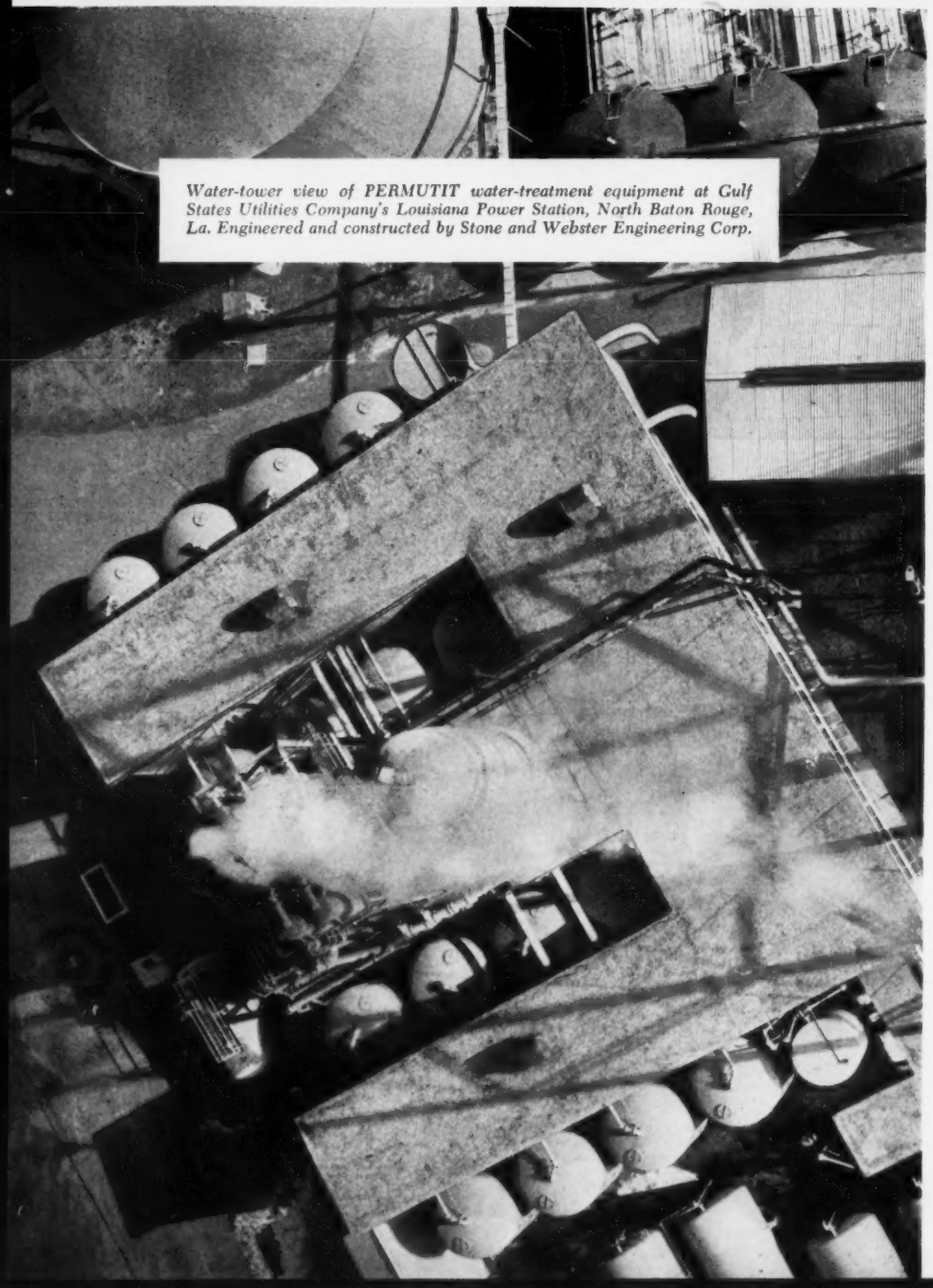
STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

Oil and Gas PACKAGED BOILERS



● Investigate the advantages obtained through the purchase of complete, modern steam generators by Erie City Iron Works. No division of responsibility — one manufacturer builds all the component parts — each part designed and engineered for maximum efficiency.



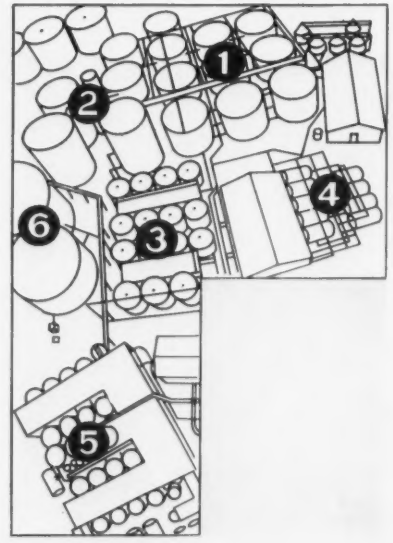


Water-tower view of PERMUTIT water-treatment equipment at Gulf States Utilities Company's Louisiana Power Station, North Baton Rouge, La. Engineered and constructed by Stone and Webster Engineering Corp.

12 million gallons of make-up per day

This station needs a *large volume* of water because it sells its steam to a refinery for process and requires 100% make-up. It needs *high-grade* water because it has adopted high-pressure boilers and turbines. It needs *efficient* treatment because it uses muddy Mississippi River water and well water with high solids and silica.

HERE'S HOW THIS 26-YEAR OLD PLANT HAS KEPT UP TO DATE *(see diagram):*



1. Original *batch coagulation and settling tanks.* Some are still used for secondary treatment of river water to reduce silica.

2. The 1931 roughing sedimentation tanks were converted to modern up-flow *Precipitators* in 1938 . . . cutting hardness 20%, turbidity 40%—and tripling capacity.

3. *Gravity filters* polish the clarified river water prior to softening.

4. Old Zeo-Dur® *zeolite softeners* were converted to new Zeo-Karb® exchanger in 1937 . . . boosting each unit's capacity 55%.

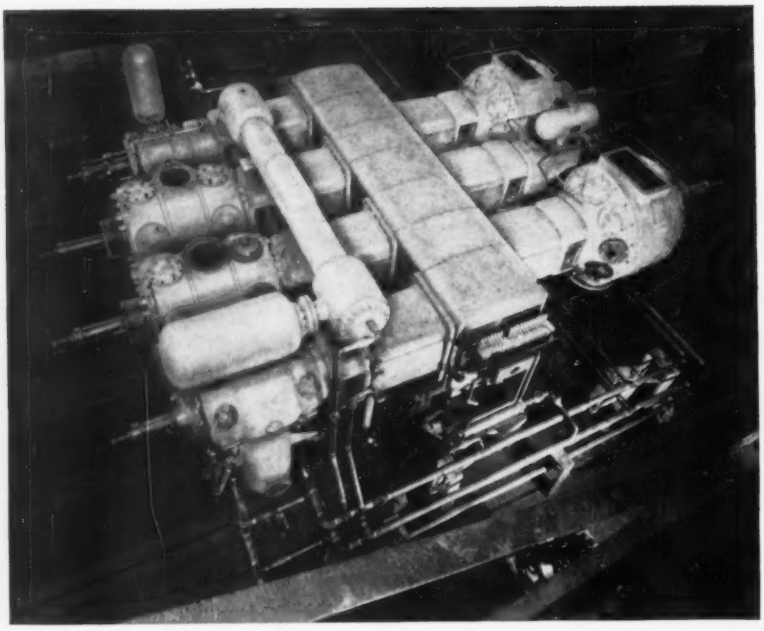
5. *Demineralizers* for new high-pressure boilers were added in 1955. They treat 3500 gpm, reduce dissolved solids of well water from 271 to under 2.0 ppm and silica from 25 to less than 0.1 ppm. Completely automatic PERMUTIT controls determine end-points, rinse, backwash and regenerate units and return them to service . . . even prepare regenerating solution.

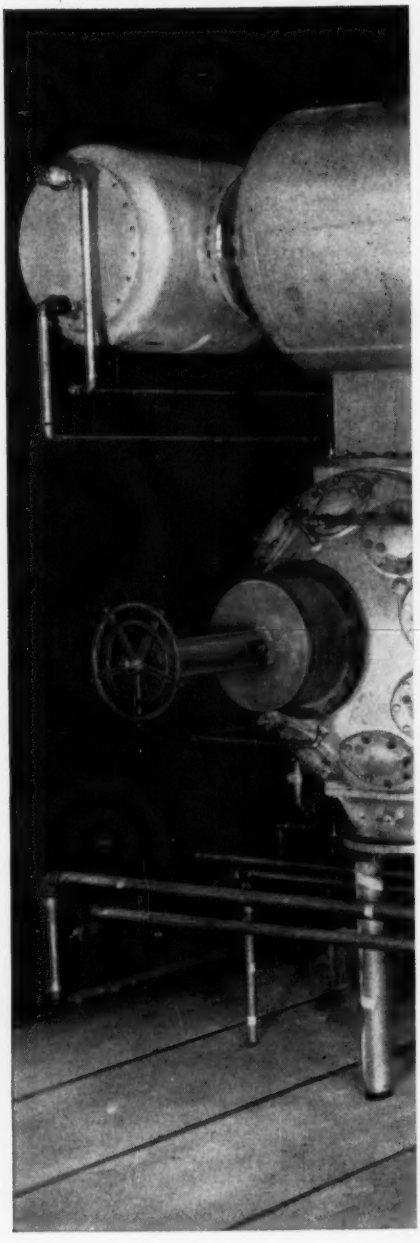
6. *Tanks* store the high-quality, low-cost demineralized feedwater.

Whether you need one piece of water-treatment equipment . . . or acres of it, PERMUTIT has the know-how . . . earned by experience. This knowledge is at your service. Write The Permutit Company, Dept. **P-3,** 330 West 42nd Street, New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

PERMUTIT®
WATER CONDITIONING
Equipment • Resins • Experience

Demineralizers • Zeolite and Hot-Process Softeners • Dealkalizers • Deaerating Heaters • Pressure and Gravity Filters • Chemical Feeders • Aerators • Blow-off equipment • CO_2 Indicating Recorders • Zeolites and Resins • Instrument Panels • Control Cubicles.





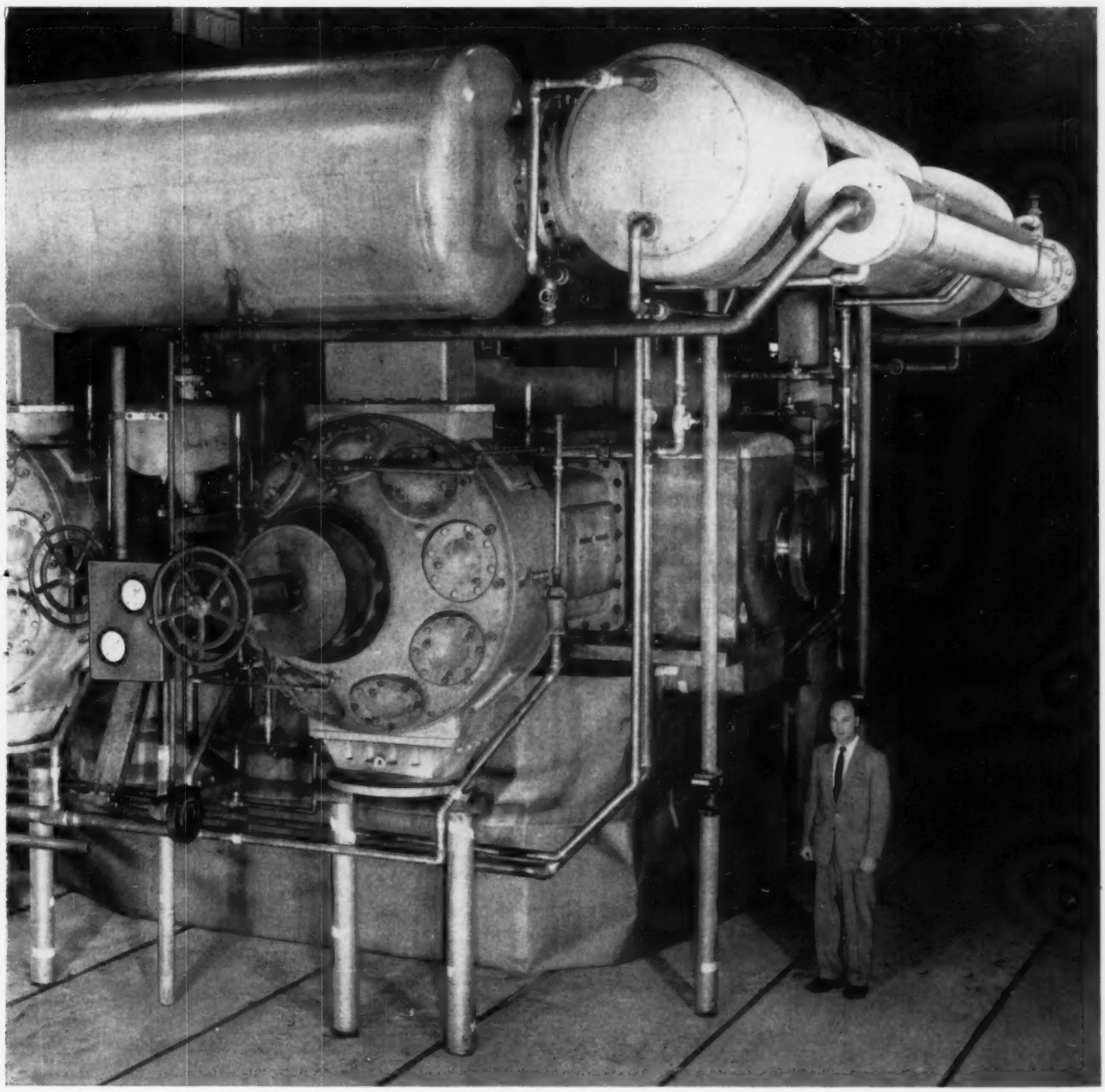
CP BUILDS 'EM BIG

This compressor *is* big! It's one of a pair of 3500 horsepower, five-stage machines built for process work.

Class FE balanced-opposed compressors are outstanding in every way – high efficiency, proved dependability, moderate ratings, accessibility. They are uniquely adaptable for widely varying conditions, in sizes up to 5000 H.P., for high vacuum or pressures up to 15,000 psig. For synthetic ammonia production, air separation, or other continuous processes, Class FE Compressors offer the utmost in efficiency and availability.

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS



Variable volume clearance pockets on all stages of this Class FE Compressor control output. All components, intercoolers and piping were factory-assembled before shipment.

Planetary Roll and

complements the Foster Wheeler line of pulverized fuel systems

THE FOSTER WHEELER Type MB planetary roll and table pulverizer, developed in Germany, is a constant-speed mill which has proved to be exceptionally efficient and economical to operate and maintain.

In the MB pulverizer, grinding action takes place between a slowly rotating horizontal table and three spheroidal rollers, uniformly spaced around the axis of the table and subjected to controlled thrust pressure by a large number of coil springs. The motion of the table causes the rollers to rotate while circling planet-fashion and rolling over the material on the grinding ring.

Air or gas, entering from below the pulverizer table, floats the ground particles up into the classifier, located in the top of the housing. Particles too coarse to float fall back onto the table for further pulverization. All routine adjustments to the spring tension gear or classifier vanes can be made externally while the mill is in operation.

Wide experience abroad indicates that this new addition to the complete line of heavy-duty FW pulverizers offers the following advantages.

1. *Low Power Consumption*

   Assures exceptional economy of operation, year after year.

2. *Low Maintenance*

   Extremely rugged construction and accessibility of wearing parts reduces down-time for servicing.

3. *Uniform Product Fineness*

   Pulverizer and classifier design assures extreme uniformity of particle size.

4. *Pressurized or Suction Operation*

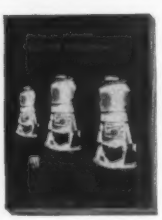
   Provides complete flexibility for various types of service.

5. *All Necessary Adjustments Made Externally with Mill Operating*

   Avoids shut-downs for changes in pulverizer pressure or classifier adjustment.

6. *Simple Renewal and Replacement of Grinding Rolls and Table*

   Cuts down-time for infrequent replacement of wearing parts.

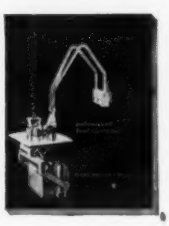


THE TYPE MB PULVERIZER, with Foster Wheeler feeders, distributors, burners and fans or exhausters, provides an exceptionally efficient and economical pulverized fuel system.

For complete information on the new PLANETARY ROLL & TABLE PULVERIZER, write for Bulletin MB-55-5.

For full details on Foster Wheeler heavy-duty BALL MILL pulverized fuel systems, write for Bulletin BP-53-3.

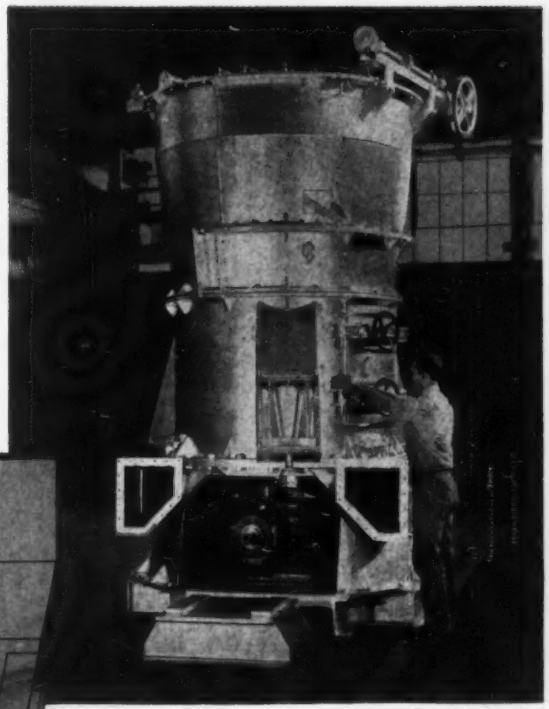
Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.



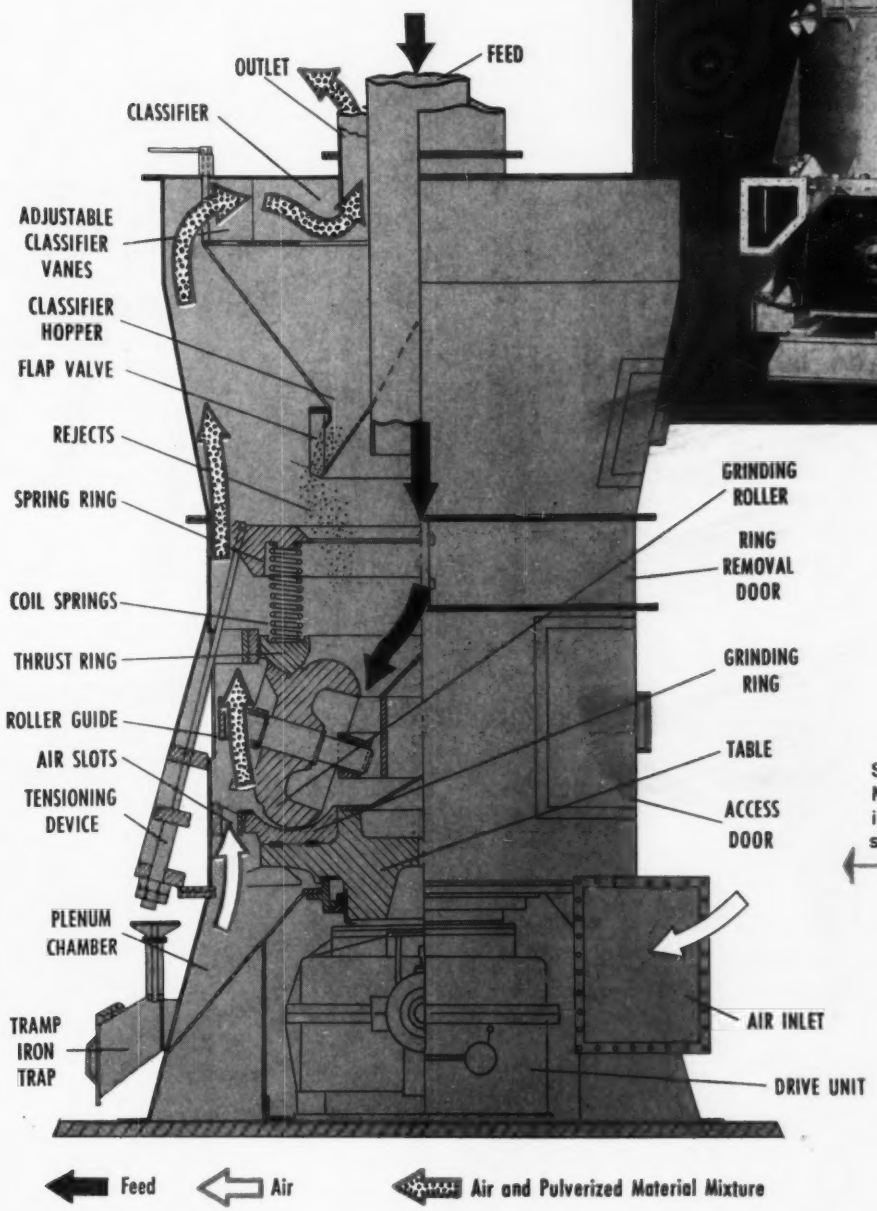
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

Table Pulverizer

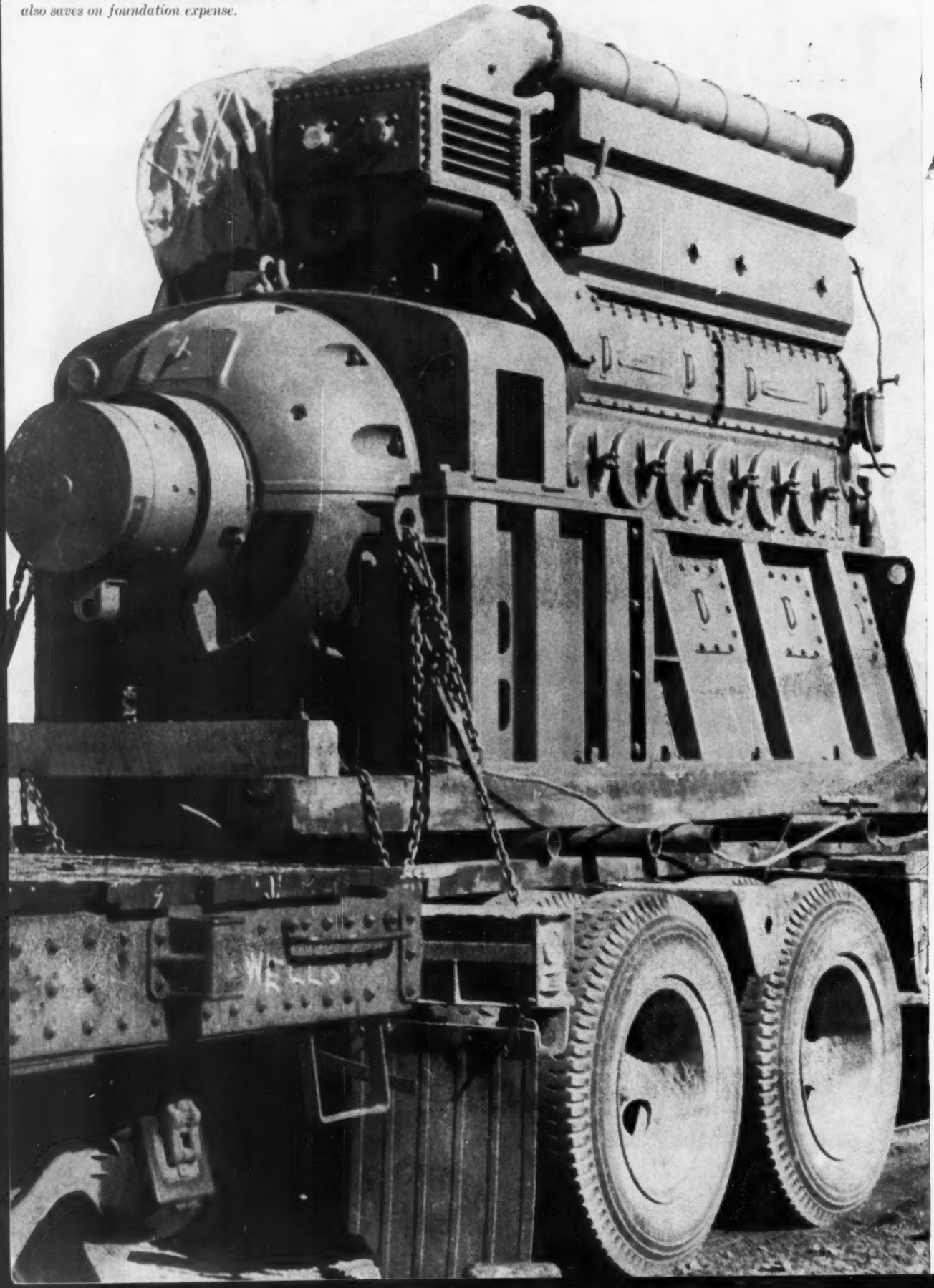


Exterior view of completely assembled Foster Wheeler Type MB planetary roll and table pulverizer.

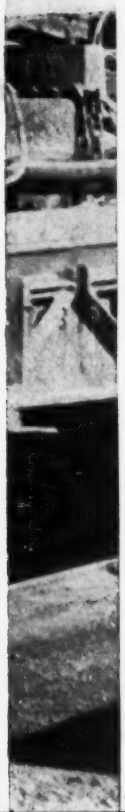


Sectional drawing of Type MB pulverizer with parts identified to show construction and operation.

500 KW IN ONE PACKAGE. *This "unitized" engine generator shipped already assembled, requires no aligning at the site. Its compact design also saves on foundation expense.*



1957 POWER!



Long famed for reliability, Worthington 1957 power engines have many new features that can help you produce permanent or standby power at the lowest costs ever achieved for real *heavy-duty* units.

LOWER INSTALLATION COSTS—The new SW 9 engine you see at left has been "utilized" with its generator to drastically cut space requirements, installation time and expense. This design requires no aligning at the site. Should needs ever change, the entire unit can just as easily be picked up and moved to another location.

LOWER FUEL COSTS—In 1957, Worthington is pioneering in power by designing and building engines *specifically* for turbo-charged operation. The SW 14, for example, is America's first high output diesel built only for high pressure turbo-charging.

For economy today *and* tomorrow, all '57 Worthington power engines can be furnished to run on the lowest cost, locally available fuels—residual, crude, and distillate oils; natural, sewage, propane or manufactured gas.

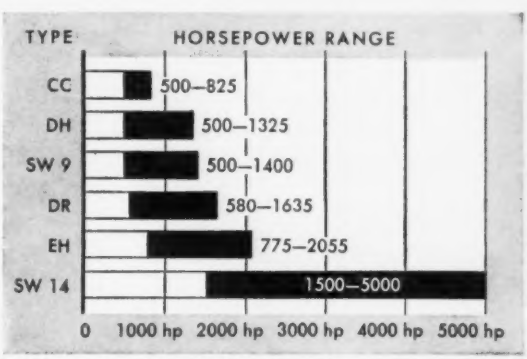
LOWER MAINTENANCE COSTS—With Worthington's 1957 engine line, you enjoy the economy of modern power design plus amazingly low maintenance. One of the many maintenance-saving features of the new SW 9, for example, is the Jet Swirl combustion chamber. The chamber is designed so that the air swirls as it enters the cylinder assuring rapid mixing of air and fuel for extremely clean combustion giving longer valve and liner life, as well as ultra-efficient operation.

The fact that every upper mechanical part is within reach from the operating level is another maintenance saving feature.

For reliable power in the 500 to 5,000 hp range, at the lowest possible cost, get in touch with your nearest Worthington District Office. Worthington Corporation, Harrison, N. J. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ont.

E-7-1

Choose your next diesel from Worthington's complete line of heavy-duty four-cycle power engines.



WORTHINGTON

■ The 16,000 users of YARWAY Blow-Off Valves include utilities, industrial plants, institutions and government installations—well-known plants and plants you've never heard of; large plants, small plants; with boilers of every pressure rating.

But there's one thing these companies have in common—*dependable blow-down service.* Their YARWAY Blow-Off Valves give them advanced engineering design, improved metallurgy, careful workmanship, exacting test standards and experienced field service.

On blow-off valves, *go* YARWAY—*with confidence.*

UTILITIES

Duke Power Co.
Boston Edison Co.
Consolidated Edison Co.
Connecticut Light & Power Co.
Eastern Shore Public Service Co.
San Antonio Public Service
Southwestern Public Service
Texas Power & Light Co.
Metropolitan Edison Co.
New Jersey Power & Light Co.
Northern States Power Co.
City of Los Angeles, Dept. of Water & Power
City of Pasadena Power Plant
Colorado Public Service Co.
Pacific Gas and Elec. Co.
Pacific Power & Light Co.
Southern Calif. Edison Co.
Washington Water Power Co.

INDUSTRIALS

Armco Steel Corp.
American Can Co.
American Viscose Co.
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Atlantic Refining Co.
Bethlehem Steel Co.
Bigelow Sanford Carpet Co.
E. I. du Pont de Nemours & Co.
Eastman Kodak Co.
Jeddo-Highland Coal Co.

YARWAY Blow-Off Valves are known by the companies

Hartford Electric Light Co.
Jersey Central Power & Light Co.
Penna. Power & Light Co.
Public Service Elec. & Gas Co. (N.J.)
Philadelphia Electric Co.
Virginia Electric & Power Co.
Alabama Power Co.
Arizona Public Service Co.
Dallas Power & Light Co.
Florida Power Co.
Georgia Power Co.
Gulf State Utilities Co.
Houston Light & Power Co.
Public Service Co. of Oklahoma
Central Illinois Public Service Co.
Cleveland Electric Illuminating Co.
Duquesne Light Co.
Indianapolis Power & Light Co.
Iowa Electric Light & Power Co.
Kansas City Power & Light Co.
Madison Gas & Elec. Co.
Nebraska Power Co.
Ohio-Edison Co.
Union Electric Co. of Missouri
Tennessee Valley Authority
Virginia Electric & Power Co.
Calif. Elec. Power Corp.
City of Burbank Power Plant
City of Glendale Power Plant
Lever Bros. Co.
Continental Can Co.
Dow Chemical Co.
Chesapeake & Ohio Railroad Co.
Aluminum Co. of America
American Bemberg Corp.
American Tobacco Co.
Celanese Corporation of America
Cities Service Oil Co.
Container Corp. of America
Humble Oil & Refining Co.
Phillips Petroleum Co.
R. J. Reynolds Tobacco Co.
Shell Oil Company
Southern Kraft Corporation

Goodyear Tire & Rubber Co.
Gulf Oil Co.
Hercules Powder Co.
Armour & Company
Buick Motor Co.
Carnegie-Illinois Steel Co.
Diamond Alkali Co.
Firestone Tire & Rubber Co.
Ford Motor Co.
International Harvester Co.
Monsanto Chemical Co.
Pittsburgh Plate Glass Co.
Procter & Gamble Co.
Standard Oil of Ohio
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Tennessee Eastman Corp.
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Crown-Zellerbach Corporation
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Metropolitan Housing Project (N.Y.)
New York Hospital
New York State Schools
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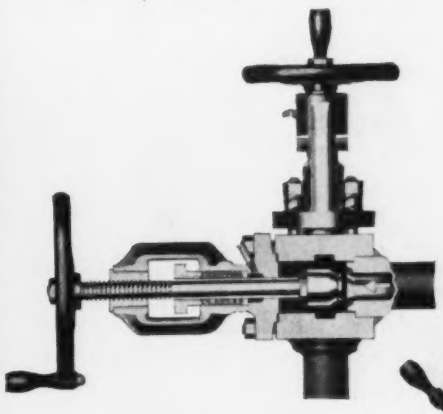
Philadelphia Public Schools
Toronto General Hospital
U. S. Veterans' Hospitals
Worcester (Mass.) State Hospital
Florida State Hospital
Kentucky State Hospital
Louisiana State Hospital
North Carolina State Hospital
Oklahoma A & M College
Oklahoma State Reformatory
Oklahoma University

Oberlin College
Penna. State University
Purdue University
Somerset (Pa.) State Hospital
University of Chicago
University of Michigan
University of Wisconsin
Calif. Medical Facility
Mare Island Naval Shipyard
Oregon State College
Puget Sound Naval Shipyard
San Quentin State Prison
Soledad State Prison
U. S. Prison (Alcatraz)
University of Calif.

they keep



Yarway Unit-Tandem Blow-Off Valve, hard-seat, seatless combination. One-piece forged-steel block serves as common body for both hard-seat blowing and seatless sealing valves. Hard-seat valve has integral, welded-in heavy stellite seat. Write for Bulletin B-434.

Yarway Seatless Blow-Off Valves, angle-straightway tandem. Note balance sliding plunger design. There is no seat to score, wear, clog or leak. Write for Bulletin B-426.

MacMillan & Bloedel, Ltd.
Pacific Lumber Co.
Richfield Oil Company
Standard Oil Co. of Calif.
Union Oil Co. of California
United Air Lines
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Texas State Hospital
Texas Technical College
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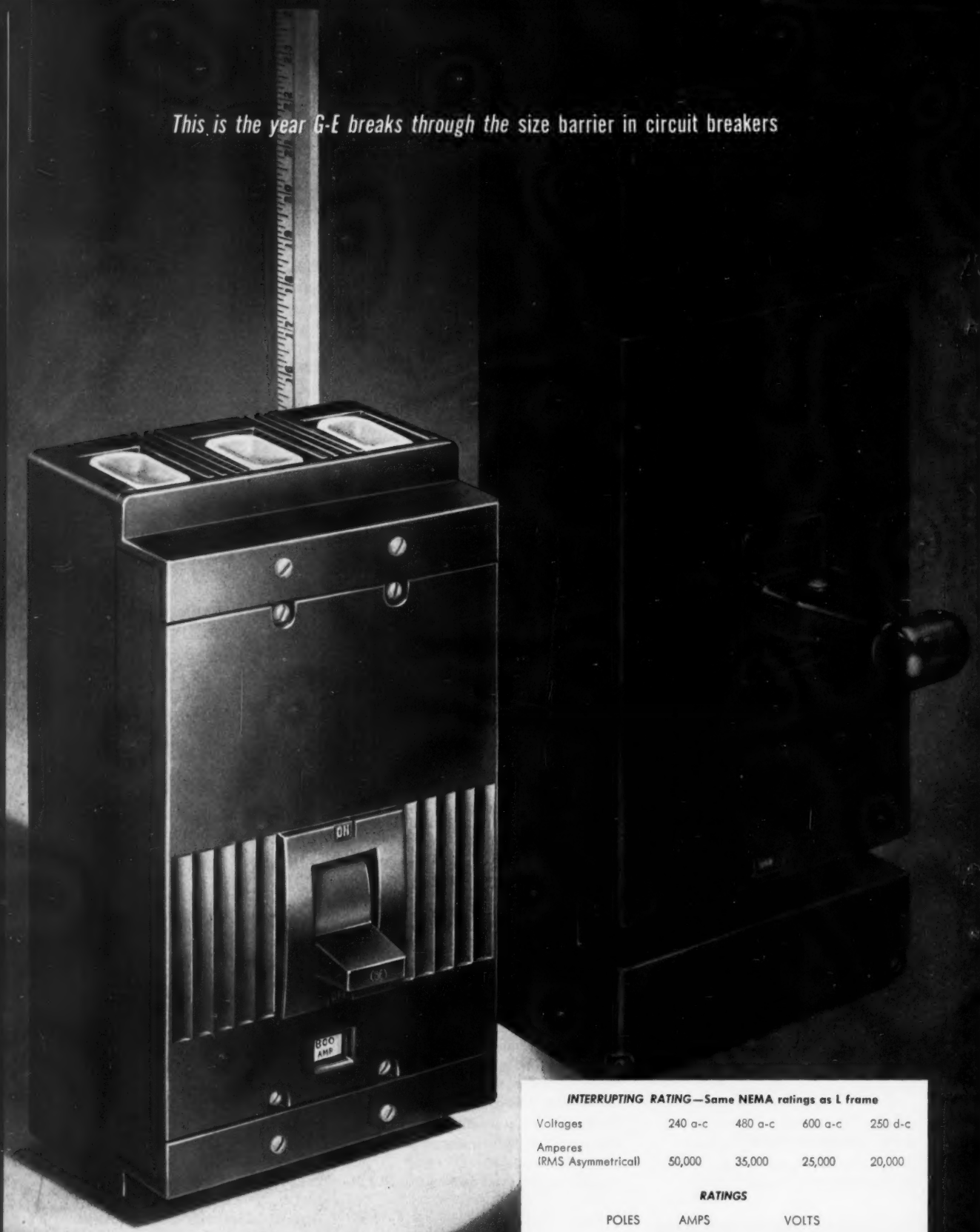
YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Penna.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

STEAM PLANT EQUIPMENT

This is the year G-E breaks through the size barrier in circuit breakers



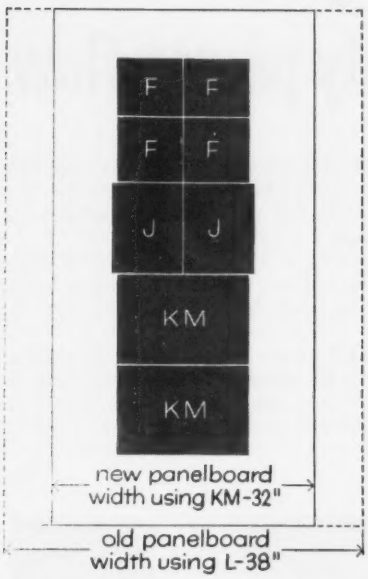
***INTERRUPTING RATING*—Same NEMA ratings as L frame**

Voltages	240 a-c	480 a-c	600 a-c	250 d-c
Amperes (RMS Asymmetrical)	50,000	35,000	25,000	20,000

RATINGS

POLES	AMPS	VOLTS
3	125-800	600 a-c
2	125-600	600 a-c, 250 d-c
	700-800	600 a-c

New 800-ampere circuit breaker needs 30% less space, cuts equipment size



In panelboard designs, you can save over six inches in width by using the KM instead of the L frame. Similar savings in valuable floor or wall space can be realized in your equipment by using the new KM circuit breaker.

New KM breaker simplifies inventory problems. You can standardize on one compact frame size instead of three for all ratings from 125 to 800 amperes

Equipment such as panelboards, switchboards and motor control centers can now be reduced in size. General Electric's new KM-frame molded case circuit breaker is 30 percent shorter than the L-frame size, and requires no more mounting area than the K frame. This new KM breaker has full L-frame interrupting ability in ratings from 125 to 800 amperes.

Smaller investments in inventory mean extra savings for you

General Electric offers you more than space savings with the KM breaker. Inventory is reduced. You no longer need to stock the KL, L and M circuit breakers. Stock only the KM frame, a supply of interchangeable trip units, three lug sizes and standardized hardware for mounting. You tie up less money in inventory because fewer parts are needed.

Enclosures and accessories are available to fit your needs. The KM is UL listed. Ask your G-E Representative to give you the full story now! *For more information write for Bulletin GED-3055 from Section 22, Circuit Protective Devices Department, General Electric Company, Plainville, Connecticut.*

The only full line of molded case circuit breakers proved at the world's largest high power testing laboratory

Progress Is Our Most Important Product

GENERAL ELECTRIC

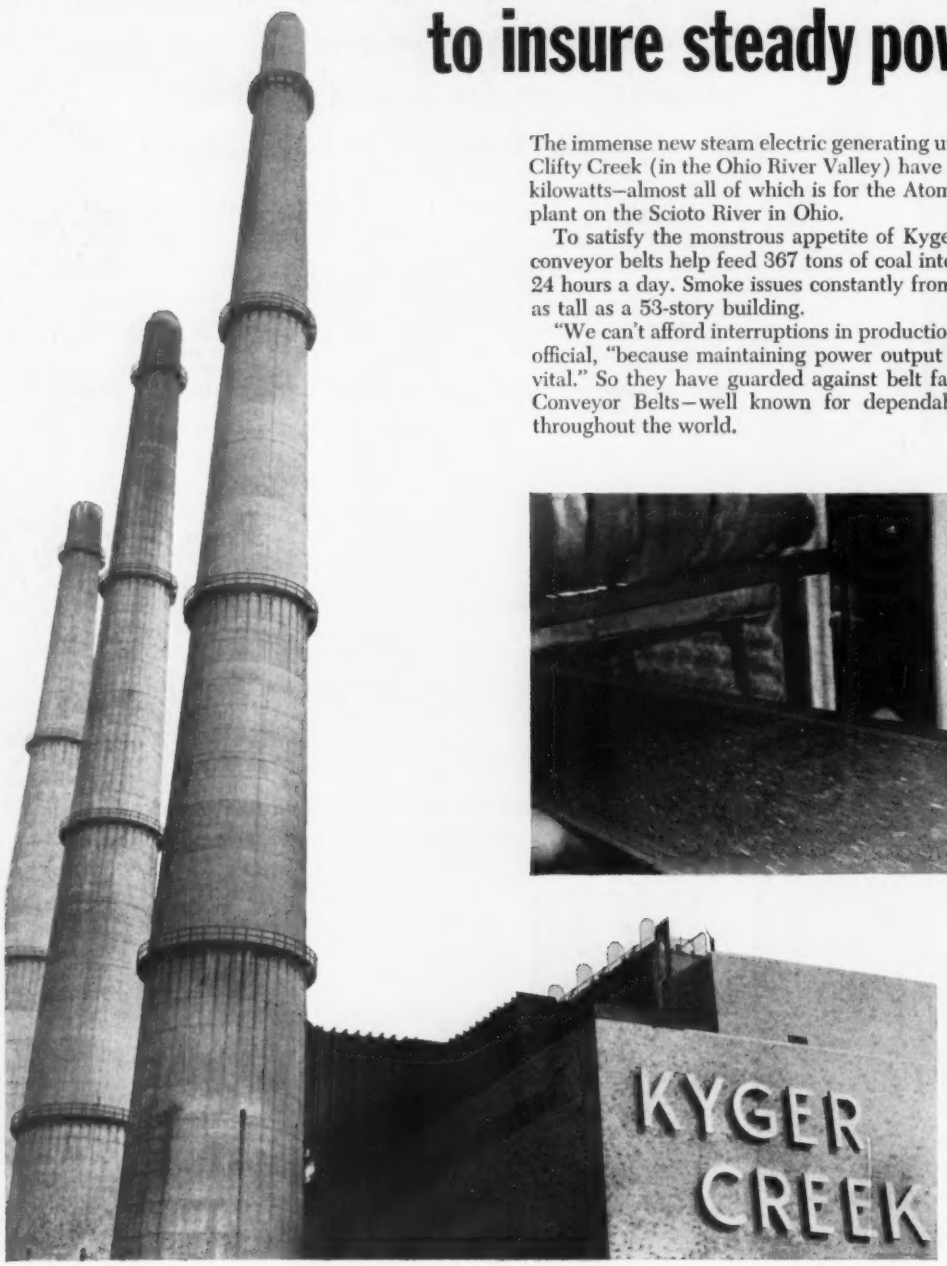
US RUBBER CONVEYOR BELTING

Delivering 367 Tons of Coal per Hour... to insure steady power flow

The immense new steam electric generating units at Kyger Creek and Clifty Creek (in the Ohio River Valley) have a capacity of 2,365,000 kilowatts—almost all of which is for the Atomic Energy Commission plant on the Scioto River in Ohio.

To satisfy the monstrous appetite of Kyger Creek, U. S. Rubber conveyor belts help feed 367 tons of coal into its boilers every hour, 24 hours a day. Smoke issues constantly from the giant stacks, each as tall as a 53-story building.

"We can't afford interruptions in production," says a ranking plant official, "because maintaining power output for the atomic plant is vital." So they have guarded against belt failure by selecting U. S. Conveyor Belts—well known for dependability by power plants throughout the world.



(above)
The Number One conveyor belt emerging from the unloader hopper at Kyger Creek. This 48" wide U. S. Matchless® belt provides excellent troughability, extreme rip resistance, fine training and long life. This excellent conveyor system and belting mean considerable savings in manpower to move the coal supply.

EXPANSION JOINTS

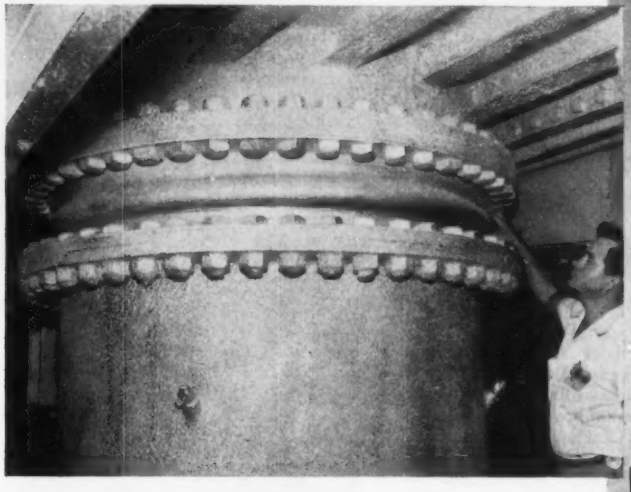
84,000 Gallons of Water per Minute for atomic energy plants

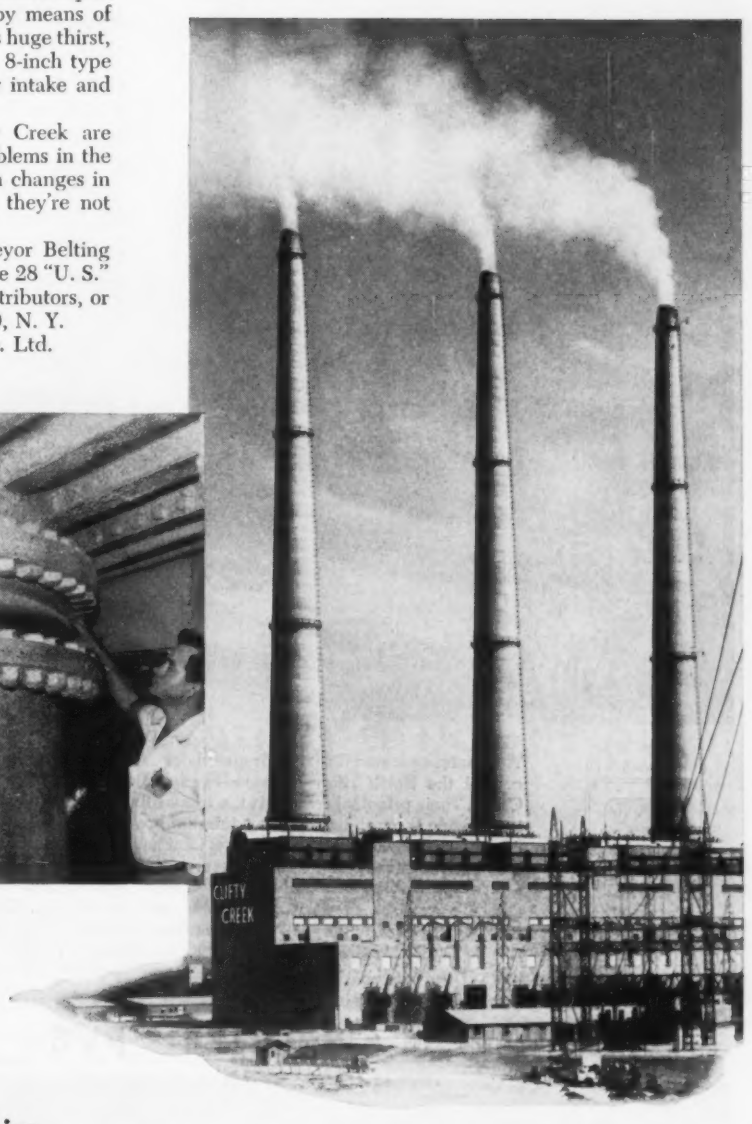
The Clifty Creek steam electric plant brings in and expels river water at 84,000 gallons per minute, by means of circulating water pumps. To help quench this huge thirst, U. S. Rubber Expansion Joints (from small 8-inch type to big 66-inch type) are used on the water intake and discharge pipes.

These U. S. Expansion Joints at Clifty Creek are handling the contraction and expansion problems in the pipe lines excellently. They can take sudden changes in temperature, they can handle shocks, and they're not bothered by corrosion.

A complete line of U. S. Rubber Conveyor Belting and Expansion Joints is available at any of the 28 "U. S." District Sales Offices, at selected "U. S." distributors, or write us at Rockefeller Center, New York 20, N. Y.

In Canada, contact Dominion Rubber Co. Ltd.

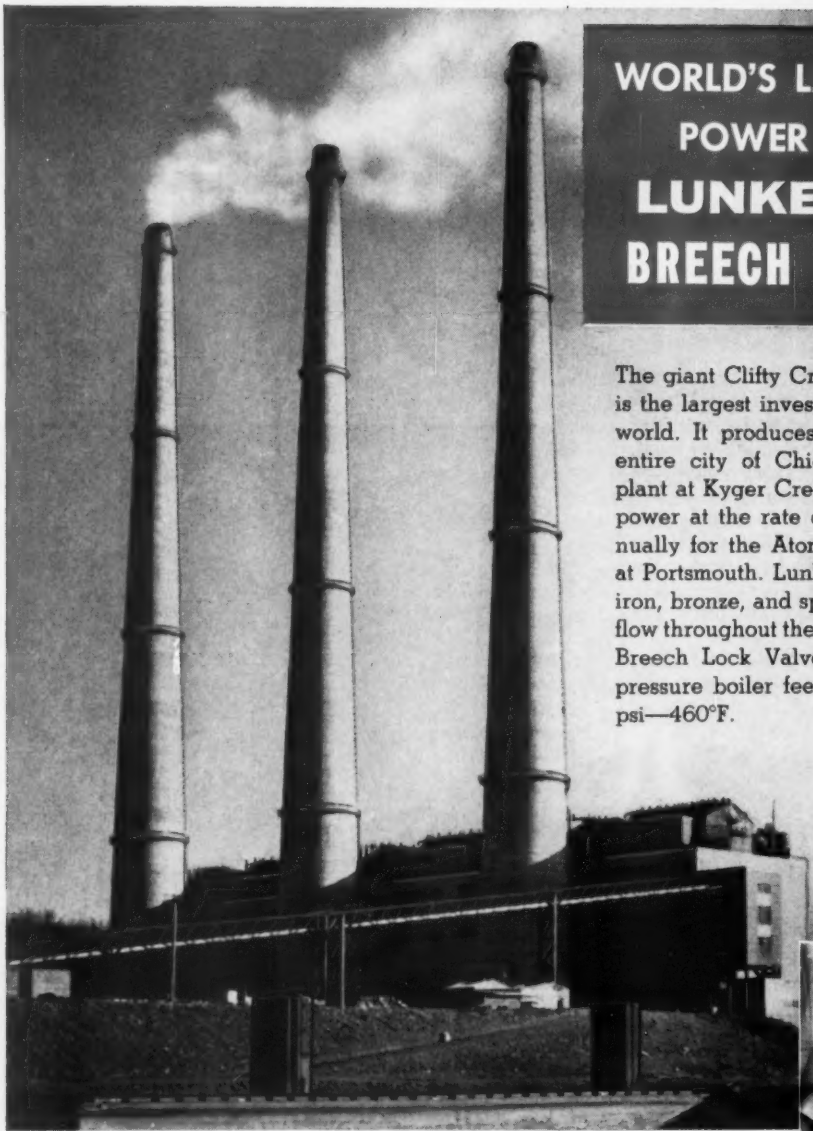




Above is one of the many 66-inch U. S. Expansion Joints on a water intake line at the Clifty Creek Plant. None of these joints, no matter what the size, has ever given Clifty Creek any problem. They are performing excellently, on a tough job.

Mechanical Goods Division

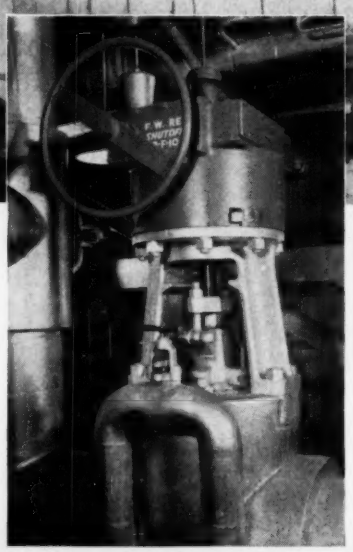
United States Rubber



WORLD'S LARGEST PRIVATE POWER PLANT USES LUNKENHEIMER BREECH LOCK VALVES

The giant Clifty Creek Plant at Madison, Indiana, is the largest investor-owned power facility in the world. It produces enough power to supply the entire city of Chicago. Together with its sister plant at Kyger Creek, Cheshire, Ohio, it provides power at the rate of 17 billion kilowatt-hours annually for the Atomic Energy Commission center at Portsmouth. Lunkenheimer Valves in steel, cast iron, bronze, and special alloys are used to control flow throughout the plant. Exclusive Lunkenheimer Breech Lock Valves are used to regulate high-pressure boiler feed water at maximums of 3000 psi—460°F.

Stacks at Clifty Creek are 682 feet high—the world's tallest. Clifty Creek is owned and operated by Indiana Kentucky Electric Corporation, a subsidiary of the Ohio Valley Electric Corporation, a group of 15 major power generating utilities.



LUNKENHEIMER QUALITY

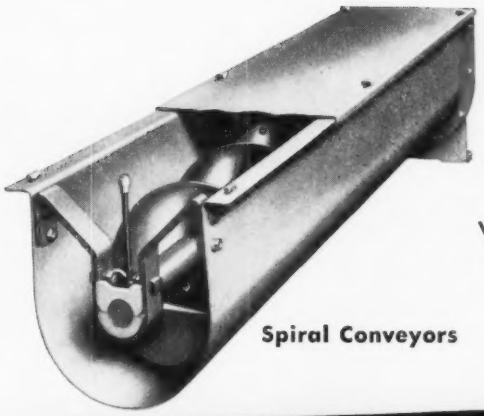
The motor-operated 12-inch Breech Lock Valves shown here control the North High Pressure Feed Water Inlet at Clifty Creek. Their principal feature is the transmittal of bonnet thrust to the body through interlocking, internal breech-lugs, with the final pressure seal of the body-bonnet joint made by a seal weld. This construction permits the pressure tightness and maintenance-free service of a full-strength welded bonnet, plus the added advantage of easy disassembly and reassembly. The weld can be readily chipped out if necessary. *Write for literature* to The Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

STEEL • IRON • BRONZE • PVC

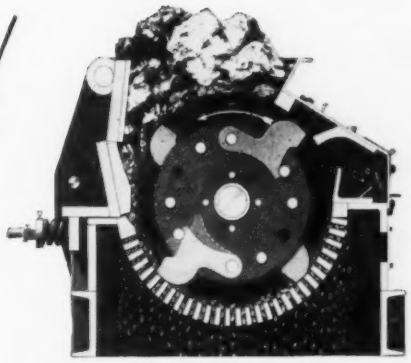
L-956-33

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

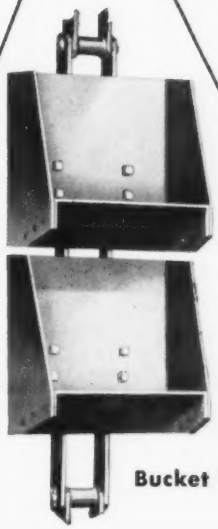


Spiral Conveyors

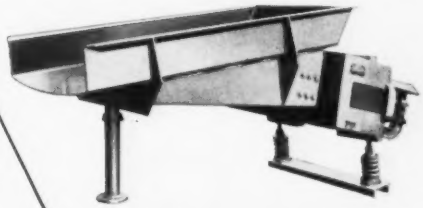


Flextooth Crushers

Scraper Conveyors



Bucket Elevators



Electric Vibrating Feeders

JEFFREY DEPENDABILITY counts most in equipping and operating a power plant

A high standard of design, materials and workmanship has made Jeffrey coal and ashes handling equipment the choice of leading power plant engineers. Whether you're planning a complete plant or revamping an old one, consider these Jeffrey products—

Spiral Conveyors for distributing coal to bunkers and hoppers are ideal where space is limited and capacity demands are not high. Coal can be discharged at any point by means of valves in trough bottoms. Available in various standard lengths.

Flextooth Crushers reduce lump coal to uniform sizes in a single operation, assuring maximum efficiency for mechanical stokers. An adjustable breaker plate permits making a wide range of sizes.

Electric Vibrating Feeders regulate flow to belts, elevators, pulverizers, weigh hoppers, etc., drawing feed from track hoppers and storage bins. Operate on the level, up or down grade. Impart no vibration to supporting structures. Capacities up to 600 tons per hour.

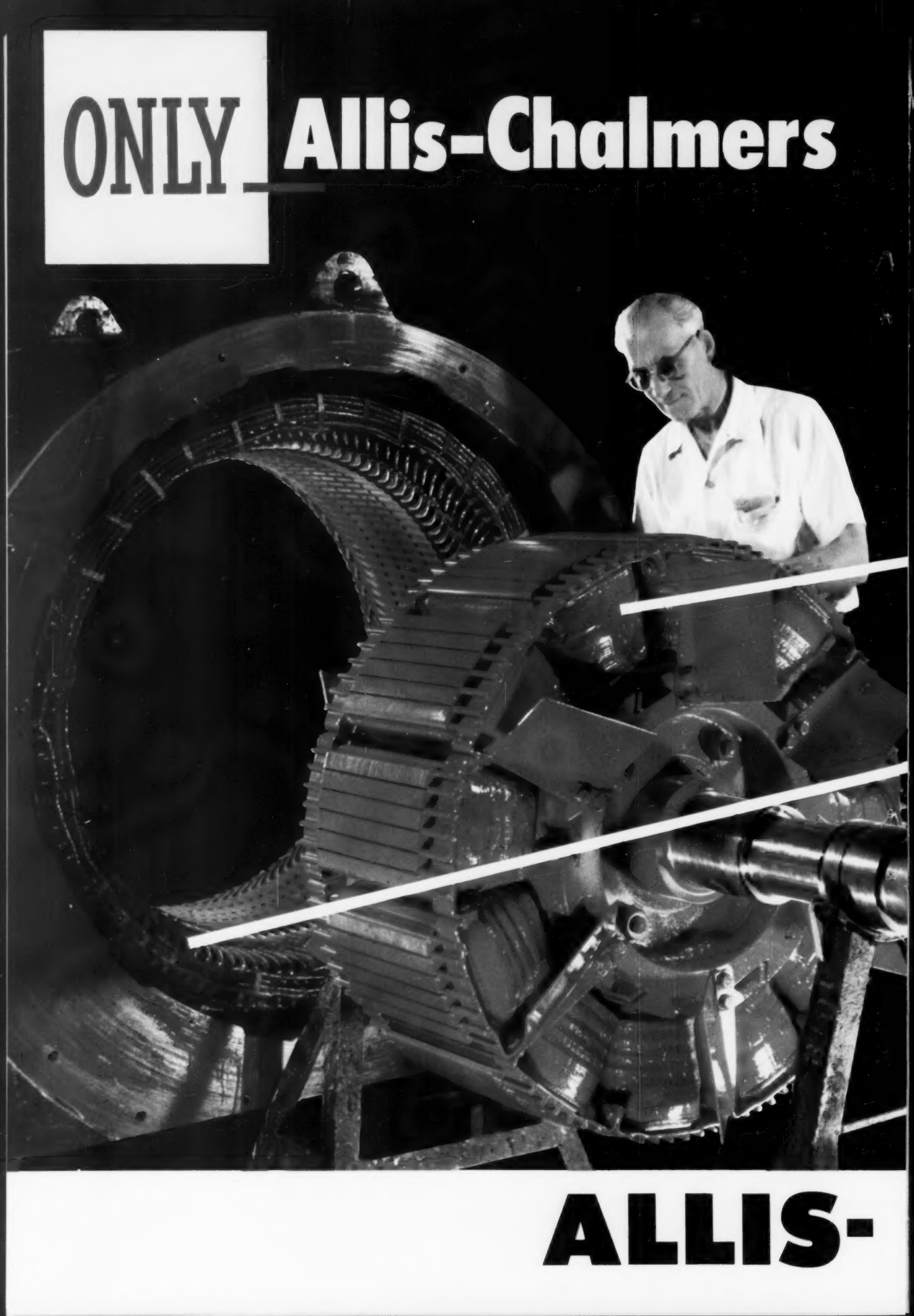
Bucket Elevators provide continuous handling of coal and ashes at low cost and require a minimum of space. Jeffrey furnishes elevators in various heights and in capacities of 25 to 40 tons per hour. Certain types can be employed for elevating and also for distributing coal to bunkers.

The Scraper Conveyor is one of the simplest of conveying units. Flights of various shapes, attached to either single or double strands of chain, drag the material in a steel trough. Operation may be horizontal or on an incline.

Detailed information on Jeffrey equipment for power plants is available upon request. The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING


ONLY Allis-Chalmers
ALLIS-

MOTORS are "double protected"

New Integrated Field Coils Plus *Silco-Flex* Stator Insulation Provide Superior Motor Protection... Under Any Operating Conditions

1

Integrated Field Coils are bonded in heat-stabilized resins, enclosed in a resin-impregnated sheath of oriented glass fibers and bond-locked on the pole structure . . . dimensionally stable to withstand heating and thermal shock, vibration and fatigue at elevated temperatures . . . sealed throughout against atmospheric contaminants and fully protected against destructive forces.

2

***Silco-Flex* Insulation** provides a homogeneous, void-free insulating wall of silicone rubber on stator coils. It is unexcelled in life and thermal stability at high temperatures . . . resistant to most chemicals, water, weather . . . outstanding in flexibility and resilience . . . able to withstand abrasion and corona . . . resistant to physical and mechanical forces.

Exclusive Allis-Chalmers "double protection" is available on large electrical machines with operating temperatures through Class B range.

Silco-Flex is an Allis-Chalmers trademark.

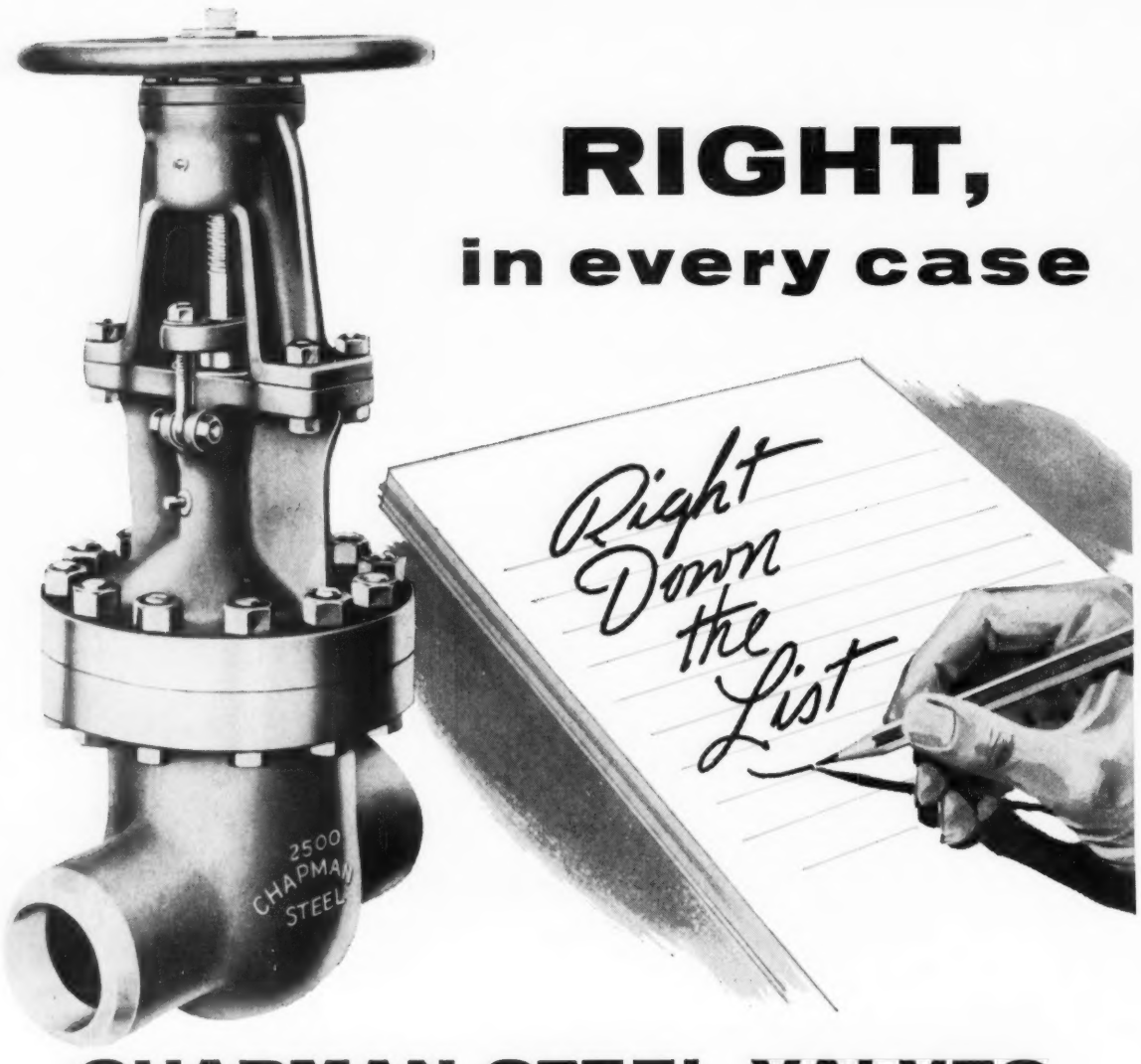
For more information on these quality insulation systems contact your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin for Integrated Field Coil Bulletin 05R8525 and *Silco-Flex* Insulation Bulletin 05R8341.

Allis-Chalmers "Double Protection," with integrated field coils and Silco-Flex stator coil insulation, adapts this 600-hp, 2300-volt, 600-rpm synchronous motor to the most severe operating conditions.

CHALMERS

A-C ALLIS-CHALMERS

A-5221



RIGHT, in every case

CHAPMAN STEEL VALVES

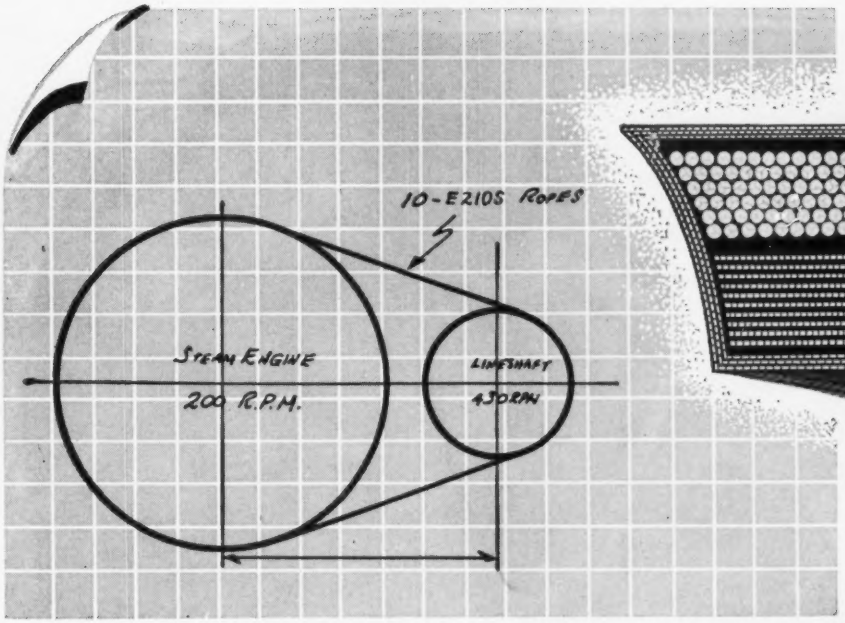
Check them off, one by one. They're all important to you, a user of valves . . . steel valves. You want close tolerances; tight and positive seats; smooth, dependable, operation without jamming, chattering or excessive wear. Even with long service under the most severe conditions you want to cut your maintenance costs to a new rock bottom low.

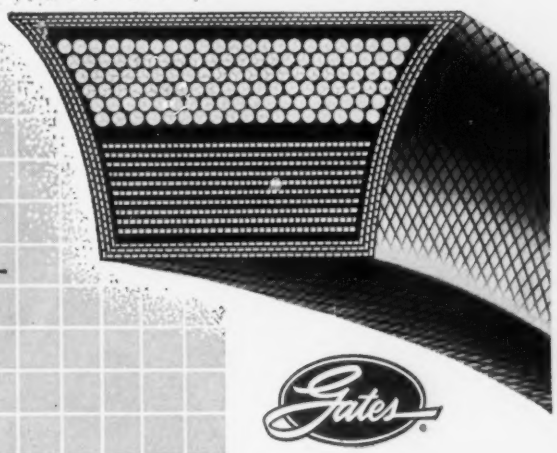
Name your metal. You can have Chapman Steel Valves in standard alloys for normal requirements . . . or special alloys for extra service conditions. And for *your* benefit, all of these alloys are poured in Chapman's own foundries under rigid technical supervision.

Chapman superior steel valves — gates, globes, checks — are available for all pressure and temperature ranges. You can order them with bolted, welded or pressure seal body and bonnet joints and with flanged or welding ends. They all equal or exceed ASA and API standards in every range.

Why not write now for our complete descriptive catalog No. 20.

THE
CHAPMAN
VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASS.





MORE HP DELIVERED PER $ INVESTED

On any new drive design—where you have limited space or you need to keep weight down—here is an important fact that can save you money:

A Gates Super Vulco Rope drive will deliver more horsepower per dollar invested than any standard V-belt drive.

Actually, the greater load carrying capacity of Super Vulco Ropes cuts down the number of belts required (5 Super Ropes do the work of 7 standard belts) . . . thus reducing the width of sheaves.

Sheaves with fewer grooves not only cost less, they weigh less, and take up less room—advantages that can easily improve the design and lower the overall cost.

A wealth of drive data is quickly available to you. Simply call your nearby Gates V-Belt Distributor (see 'phone book yellow pages) for a Gates V-Belt Specialist. Stocks available in industrial centers around the world. The Gates Rubber Co., Denver, Colorado—*World's Largest Maker of V-Belts.*

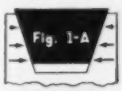
4 BIG PLUSES

✚ *Handles shock loads*

Super-strength cords provide 40% greater horsepower capacity . . . easily absorb heavy shock loads.

✚ *Wears far longer*

Concave Sidewalls (Fig. 1) increase belt life. As belt bends, concave sidewalls (U.S. Pat. No. 1813698) become straight, make uniform contact with sheave groove (Fig. 1-A). Uniform contact means less wear on sides of belt . . . longer V-belt life.



Flex-Weave cover (U. S. Pat. No. 2519590) provides greater flexibility with far less stress on fabric. Cover wears longer—increases belt life.

✚ *Provides Static Safety*

High electrical conductivity is built into Gates Super Vulco Ropes for safer drives (in explosive atmospheres).

✚ *Resists oil, heat and weather*

Special rubber compounds with which cords and fabric are impregnated make Super Vulco Ropes highly resistant to heat, oil and prolonged exposure.

TPA 76B

Gates Super VULCO ROPE Drives

Simplicity . . . Versatility, Too

A wide variety of models, ranges and accessories are available for exact matching of Brown thermometers and pressure gages to your specific applications.

Simplicity...

you'll find it in Brown thermometers and pressure gages

CLEAN, SIMPLE DESIGN—simplicity that minimizes operating or maintenance difficulties—sets Brown thermometers and pressure gages apart. Using direct, simple linkages, these rugged instruments have few elements. Basic components for both thermometers and pressure gages are interchangeable, and cases are identical. Maintenance is easy and your spare parts requirements are reduced. This is simplicity that will pay off in many years of reliable, economical service.

And with this simplicity comes dependable, high accuracy. The many narrow spans available, together with the large charts and scales, give you the full use of this accuracy.

Brown thermometers are particularly suitable for the intermediate temperature range, extending from —125 to 1000 F. Brown pressure gages are available in many ranges, with a minimum of absolute zero and a maximum of 4,000 psi.

Your nearby Honeywell sales engineer will gladly give you complete details on these instruments as they relate to your particular requirements. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

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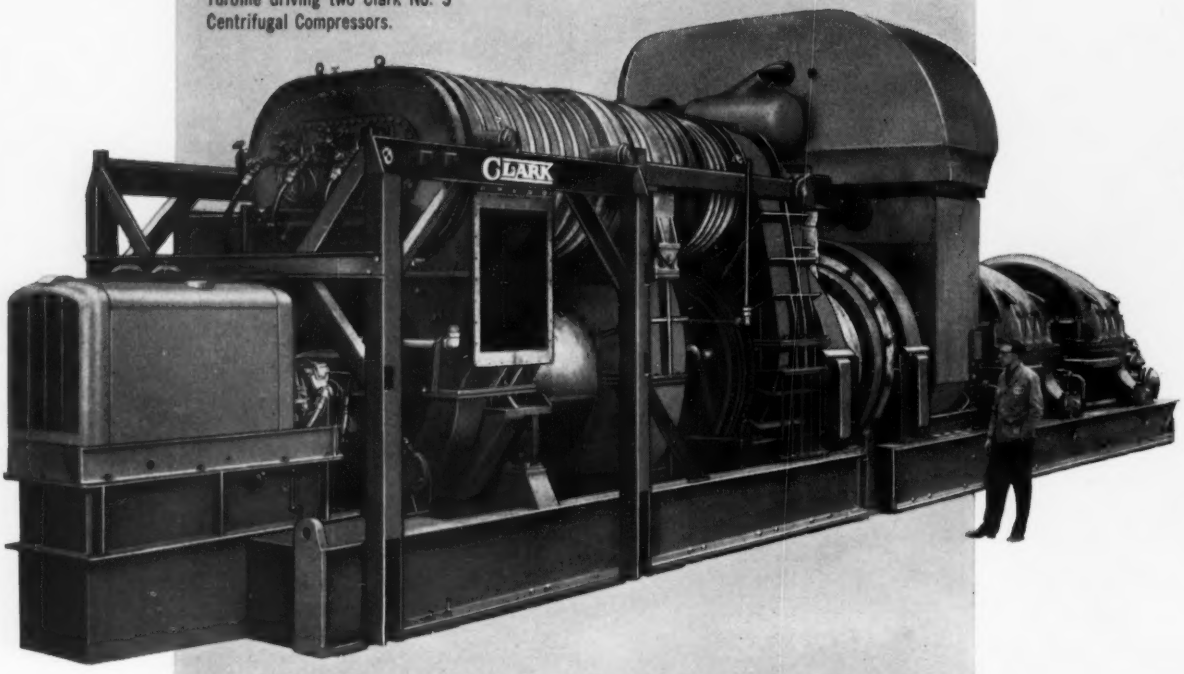
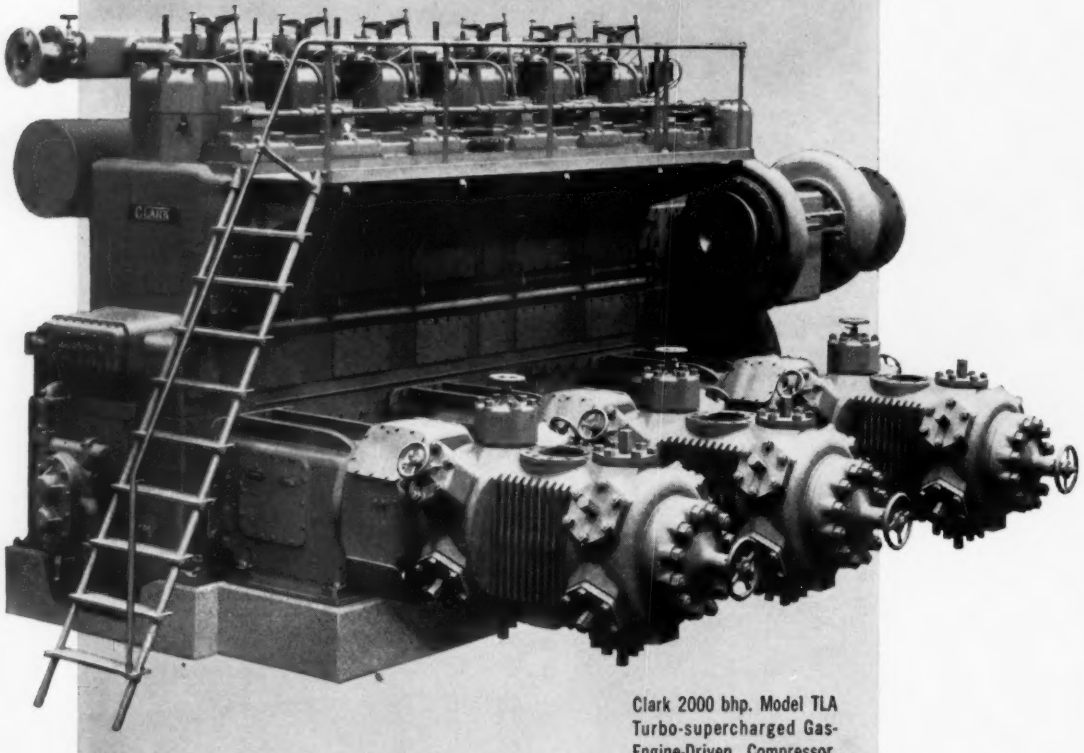
MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

Clark 8500 bhp. Model 302 Gas Turbine driving two Clark No. 5 Centrifugal Compressors.





Clark 2000 bhp. Model TLA Turbo-supercharged Gas-Engine-Driven Compressor.

Gas turbines or engines?

With Clark you eliminate

Prejudice

Gas turbine-driven centrifugal compressors or reciprocating compressors... you can get both types from Clark

Prejudice can add substantially to the cost when selecting compressors. At Clark, we build both gas turbine-driven centrifugal compressors and gas-engine-driven reciprocating compressors. In both instances the compressors and drivers are the most modern available.

Our chief concern is to be certain that you obtain the proper unit for your specific installation. This is where our experienced application engineers enter the picture. Both types of units have certain characteristics that may make one or the other best for your particular use. An unbiased opinion, after a careful examination of all the facts and conditions, is vitally important. Clark is the only company that can give you an unbiased opinion because Clark is the only company that builds reciprocating and centrifugal compressors in addition to gas turbines.

Clark application engineers will be pleased to help you determine the right type of compressor and driver combination for your next application.

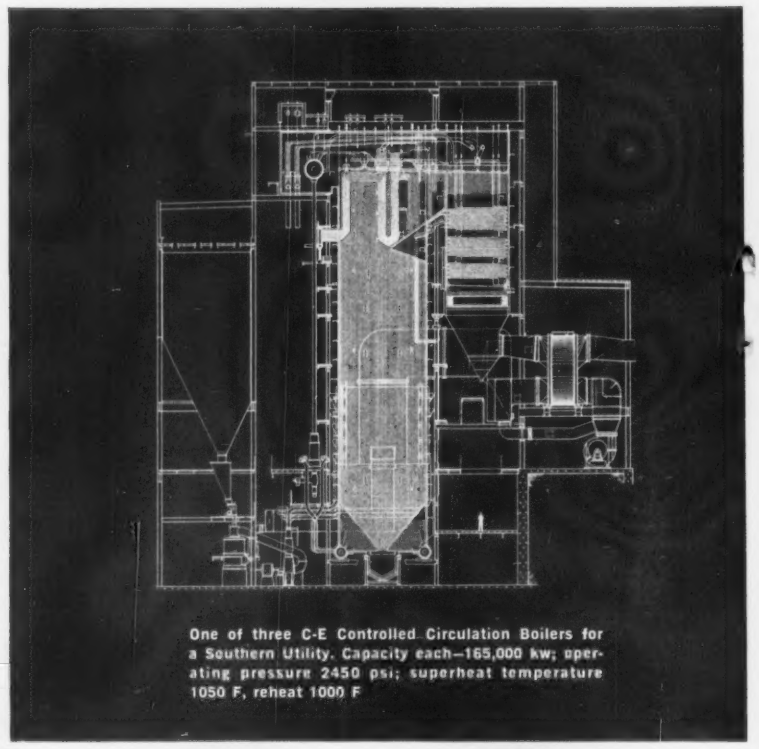
CLARK BROS. CO., OLEAN, NEW YORK

One of the Dresser Industries

Offices in Principal Cities Throughout the World

CLARK®

Centrifugal Compressors
Reciprocating Compressors
Gas Turbines



One of three C-E Controlled Circulation Boilers for a Southern Utility. Capacity each—165,000 kw; operating pressure 2450 psi; superheat temperature 1050 F, reheat 1000 F

2400

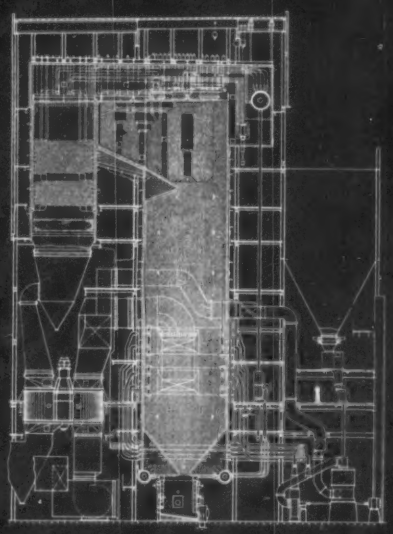
The Outstanding

In 1956, the most notable trend in power plant practice was the large-scale adoption of the 2400 lb pressure cycle. In this pressure range, the utility industry purchased more than twice as many C-E units as they did in 1955. These units range in size between 125 mw and 325 mw. Operating pressures ***at the turbine throttle*** range from 2400 psi to 2620 psi. Of course, all are Controlled Circulation Boilers and 3 units are of the C-E Sulzer "once through" design. All units are equipped with C-E Tilting Tangential Burners and, in the larger sizes, a number are of the C-E Twin Furnace design.

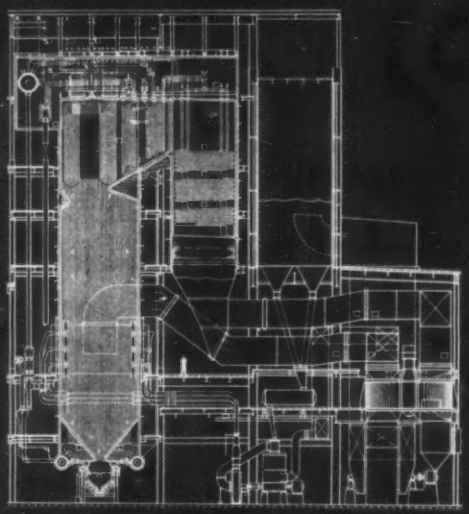
COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;



One of two C-E Controlled Circulation Boilers for a Mid-Western Utility. Capacity each — 200,000 kw; operating pressure—2500 psi; superheat temperature 1050 F, reheat 1050 F



One of two C-E Controlled Circulation Boilers for an Eastern Utility. Capacity each—200,000 kw; operating pressure—2460 psi; superheat temperature 1050 F, reheat 1000 F

PSI

Power Trend of 1956

Orders placed for C-E Boilers in this pressure range, including three purchased prior to 1955, now total 32 units with an aggregate capacity of over 5,500,000 kilowatts. This remarkable record is attributable to the proven suitability of the C-E Controlled Circulation Boiler for the highest range of sub-critical pressure and to its outstanding performance, especially with respect to availability.

The capacity of all C-E Controlled Circulation Boilers ordered since 1950—covering a range of turbine throttle pressures from 1500 to 2620 psi—now totals well over 16-million kw of which approximately 5½-million kw is in service. The cumulative service of these installations is equivalent to more than 60 boiler years.

As this record demonstrates, Combustion designs have anticipated advancement in power practice and have made a significant contribution to the all-important industry objective of achieving ever lower generating costs.

ENGINEERING

200 Madison Avenue, New York 16, N. Y.

C-E

B-980A

C-E's complete line of industrial boilers includes a type and size just right for your steam needs.

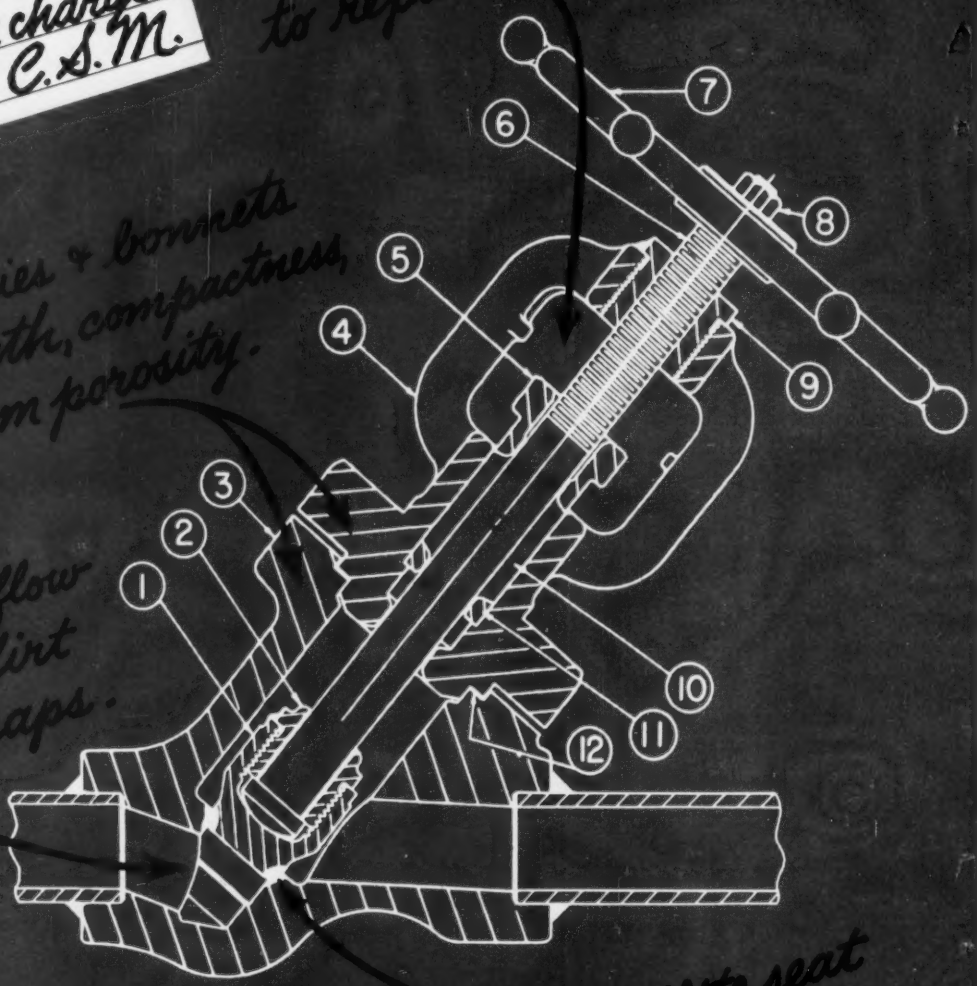
PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

R. G. R.–
All boilermakers
Approve Edward
Blow-Off Valves–
will supply them
without extra charge.
C. S. M.

An operator can get his fingers in this yoke to repack valve.

Forged bodies + bonnets give strength, compactness, freedom from porosity.

Streamlined flow eliminates dirt and scale traps.



Integral stellite seat is best for Blow-Offs– unaffected by temperature changes.

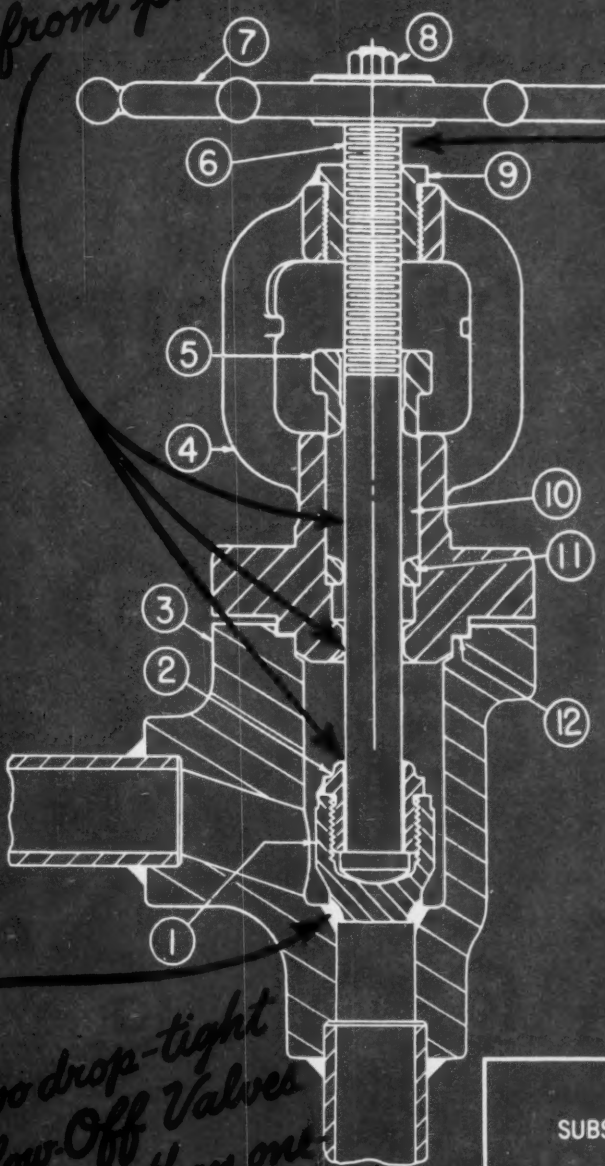
LIST OF MATERIAL
QUANTITIES ARE FOR 1 STRAIGHTWAY OR 1 ANGLE VALVE
WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED THE LATEST REVISION APPLIES

PIECE NO.	NAME OF PIECE	NO. REQ'D	MATERIAL	SPECIFICATIONS	EDWARD MS NO.
1	DISK	1	FORGED ALLOY STEEL WITH	STELLITED SEATING FACE	227 483
2	DISK NUT	1	STEEL	A.I.S.I. G1120	123
3	BODY	1	FORGED STEEL WITH	A.S.T.M. A105 GRADE II STELLITED SEATING FACE	111 483
4	BONNET	1	FORGED STEEL	A.S.T.M. A105 GRADE II	111
5	GLAND	1	MALLEABLE IRON	A.S.T.M. A220, GRADE 53004	324
6	STEM	1	EVALLOY	A.I.S.I. GRADE 416	261
7	HANDWHEEL	1	MALLEABLE IRON	A.S.T.M. A47 GRADE 32510	322
8	STEM NUT	1	STEEL	A.S.T.M. A194 - CLASS 1	124
9	YOKE BUSHING	1	BRONZE	A.S.T.M. B62	412
10	PACKING RINGS		EVALPAK	HIGH TEMPERATURE PACKING	501
11	JUNK RING	1	STEEL - EVALIZED	A.I.S.I. G1120	123
12	BONNET GASKET	1	IRONKOTE	ARMCO IRON 90 BHN. MAX.	505
13	GLAND BOLT WASHER	2	STEEL		
14	GLAND BOLT	2	FORGED STEEL EVALIZED	A.S.T.M. A105 GRADE II	111
15	GLAND BOLT NUT	2	STEEL - EVALIZED	A.S.T.M. A194 - CLASS O	125
16	TAP END STUD	4	ALLOY STEEL	A.S.T.M. A193 GRADE B7	208
17	BONNET STUD NUT	4	STEEL	A.S.T.M. A194 - CLASS 1	124

ROCKWELL-BUILT
EDWARD STEEL VALVES

Deep packing chamber-dependable backseat assure freedom from packing problems.

Edward Acme form threads are easy to operate at all pressures.



Gadgety designs with internal packing and sliding contacts are potential headaches.

Let's Request Edward Blow-Off Valves

Two drop-tight Blow-Off Valves are better than one - permits repair without shutdown - gives piping flexibility - parts are interchangeable.

EDWARD VALVES, INC.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.

EAST CHICAGO, INDIANA

1500 lb. FORGED STEEL BLOW-OFF VALVES

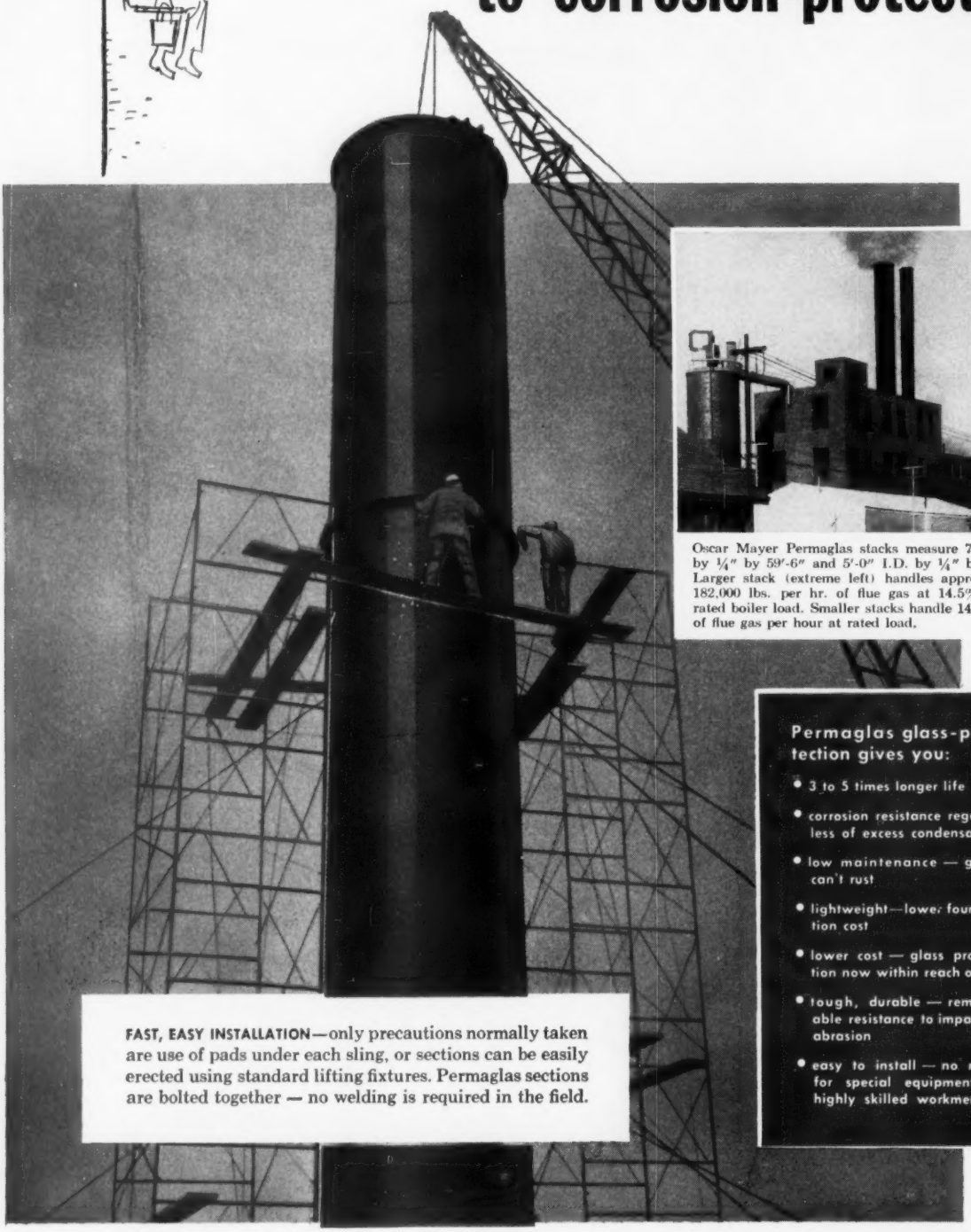
DRAWN Roberts		DRAWING Nº
CHK'D. S Rust		AE-3664-1
APPD. DeMatteis	DATE 8-27-55	

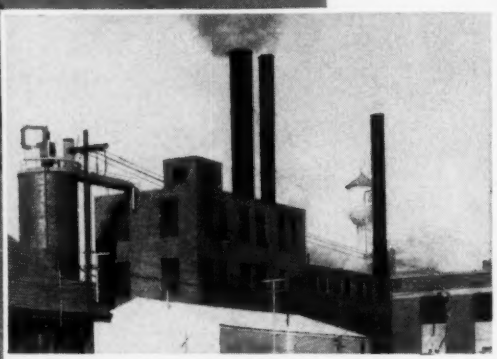
Edward builds Globe and Angle Stop, Non-Return, Stop-Check, Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

August 1955 *painter discovers dangerous corrosion in seven-year-old stack*

Prominent

to corrosion-protected





Oscar Mayer Permaglas stacks measure 7′-6″ I.D. by ¼″ by 59′-6″ and 5′-0″ I.D. by ¼″ by 77′-6″. Larger stack (extreme left) handles approximately 182,000 lbs. per hr. of flue gas at 14.5% CO_2 at rated boiler load. Smaller stacks handle 149,000 lbs. of flue gas per hour at rated load.

FAST, EASY INSTALLATION—only precautions normally taken are use of pads under each sling, or sections can be easily erected using standard lifting fixtures. Permaglas sections are bolted together — no welding is required in the field.

Permaglas glass-protection gives you:

- 3 to 5 times longer life
- corrosion resistance regardless of excess condensate
- low maintenance — glass can't rust
- lightweight—lower foundation cost
- lower cost — glass protection now within reach of all
- tough, durable — remarkable resistance to impact or abrasion
- easy to install — no need for special equipment or highly skilled workmen

meat packer converts plant 100%

Permaglas® smokestacks

Glass-protected steel stands off corrosive acid action over 3 times longer than unlined steel smokestacks

OSCAR MAYER & CO., MADISON, WIS., took immediate action and converted to Permaglas smokestacks when they discovered a dangerous corrosion condition in two plain steel stacks.

In their seven-year-old stack, the area above the lower flange of the top section was corroded to breakthrough for about one-half its circumference. The remaining half was about 1/16-in. thick. *Original thickness had been 1/4 in.* The top one-third of the stack was removed immediately for safety purposes. Investigation indicated metal thickness of 1/8 in. at the bottom of the center section and less than 3/16 in. at the base of the stack.

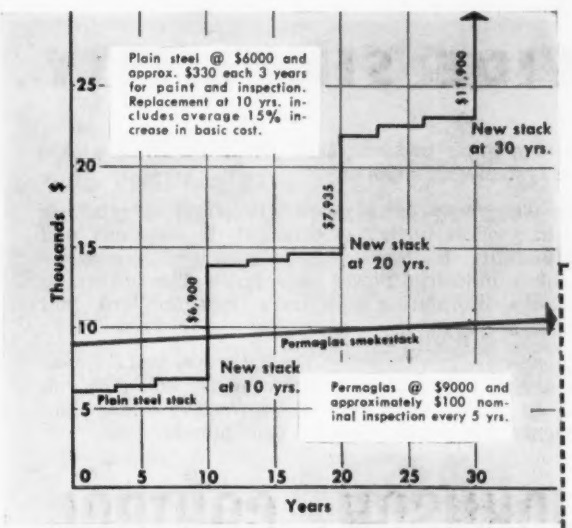
A small fifteen-year-old stack was similarly corroded by acid action of flue gas condensing out at low stack temperatures.

Recent installation of a third Permaglas stack, gives Oscar Mayer's Madison plant 100% protection against smokestack corrosion.

Why wait until trouble strikes? Why let corrosion cost you money? Surveys show that about 95% of all steel smokestack failures are caused by corrosion *inside* the stack. Stop this needless waste by converting to Permaglas smokestacks with exclusive glass protection *inside* and *out*. Contact your nearest A. O. Smith representative or write today giving details of your present stack problems or needs.

A number of Permaglas Smokestack Sales Territories are currently available. Write for details.

Permaglas savings analysis — cost approximations based on 5'-0" by 100' stack.



Over three times longer service — Based on figures furnished by plain, carbon-steel stack users. The economy of Permaglas stacks is demonstrated in the above chart.

Through research A.O. Smith *... a better way*

A.O.Smith
CORPORATION
PROCESS EQUIPMENT DIVISION
PERMAGLAS SMOKESTACK SALES
MILWAUKEE 1, WISCONSIN

A. O. Smith Corporation, Dept. P-17
Milwaukee 1, Wis.

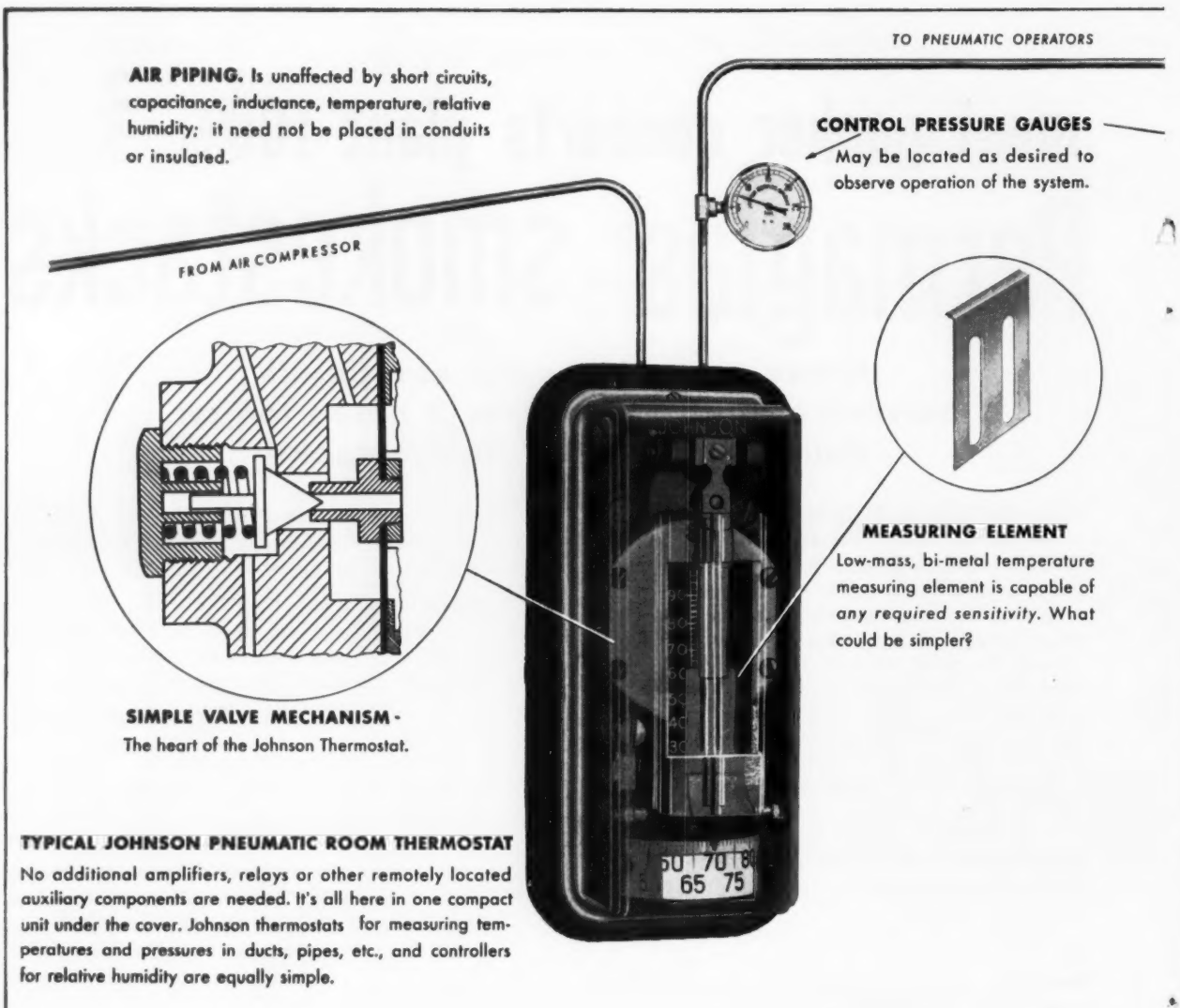
Please send me a copy of the NEW Permaglas Smokestack Bulletin No. SS-202.

Name.....

Firm.....

Address.....

City..... Zone..... State.....


TO PNEUMATIC OPERATORS
AIR PIPING. Is unaffected by short circuits, capacitance, inductance, temperature, relative humidity; it need not be placed in conduits or insulated.
CONTROL PRESSURE GAUGES
May be located as desired to observe operation of the system.
FROM AIR COMPRESSOR
MEASURING ELEMENT
Low-mass, bi-metal temperature measuring element is capable of any required sensitivity. What could be simpler?
SIMPLE VALVE MECHANISM -
The heart of the Johnson Thermostat.
TYPICAL JOHNSON PNEUMATIC ROOM THERMOSTAT
No additional amplifiers, relays or other remotely located auxiliary components are needed. It's all here in one compact unit under the cover. Johnson thermostats for measuring temperatures and pressures in ducts, pipes, etc., and controllers for relative humidity are equally simple.

INSURE SYSTEM-WIDE SIMPLICITY

For All Types of Industrial and Commercial Applications—Air Conditioning • Heating • Cooling • Ventilating • Humidifying • Dehumidifying • Processing

The basic components of Johnson Pneumatic Control, shown above, reveal how remarkably simple and free from complication the best control systems can be.

The Johnson Room Thermostat—the world's most accepted thermostat—is a refined reducing valve in a compressed air line, set and reset automatically by an accurate bi-metal temperature measuring element, to transmit compressed air, at varying pressures, to valves, dampers and other devices.

Johnson Diaphragm Valves and Damper Operators are equally simple devices with flexible, long-life diaphragms which are moved as the thermostat transmits changes in air pressure. Only pneumatic control gives you system-wide simplicity.

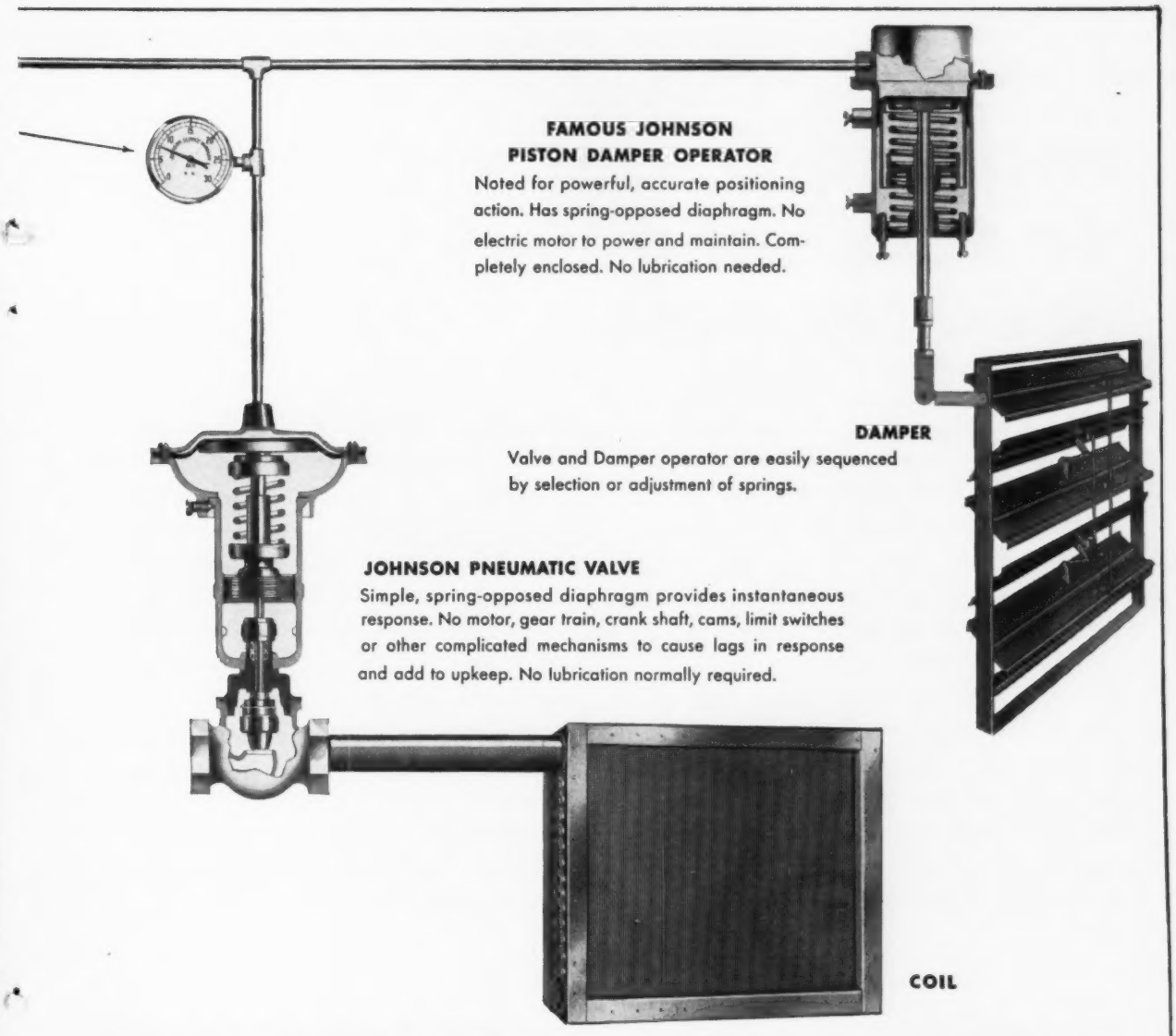
The widespread use of pneumatic power by other industries offers further evidence of its simplicity and adaptability. Examples include truck and train brake systems, industrial power tools, hoists, bus suspension systems, lubricating equipment, machine tools and countless others.

Compare *systems* carefully. You'll discover that Johnson pneumatic apparatus is simpler by far and that you can do control work with just a fraction of the components that would otherwise be required.

JOHNSON CONTROL

SINCE 1885

PLANNING • MANUFACTURING • INSTALLING



FAMOUS JOHNSON PISTON DAMPER OPERATOR

Noted for powerful, accurate positioning action. Has spring-opposed diaphragm. No electric motor to power and maintain. Completely enclosed. No lubrication needed.

DAMPER

Valve and Damper operator are easily sequenced by selection or adjustment of springs.

JOHNSON PNEUMATIC VALVE

Simple, spring-opposed diaphragm provides instantaneous response. No motor, gear train, crank shaft, cams, limit switches or other complicated mechanisms to cause lags in response and add to upkeep. No lubrication normally required.

COIL

WITH JOHNSON PNEUMATIC CONTROL

YOU'LL BE BETTER SATISFIED with PNEUMATIC BECAUSE TODAY'S PNEUMATIC CONTROL

- *Has fewer components per system.*
- *Is highly accurate, dependable—has fewer components subject to failure.*
- *Is easier to operate—easier, less costly to maintain.*
- *Offers the widest choice of compensating, sequencing and other operating features.*
- *Provides the necessary flexibility to solve even the most intricate control problems.*
- *Is completely safe under all conditions.*

Let Johnson demonstrate how the advantages of pneumatic control can be applied to your specific problems. Use the coupon or call in a nearby Johnson engineer. No obligation, of course.

WIDEST EQUIPMENT SELECTION

Johnson makes the most complete line of pneumatic control equipment for solving any problem of temperature, humidity or pressure control. Equipment includes thermostats, recorder-controllers, valves, dampers, damper operators, pressure regulators, humidostats, humidifiers, thermometers, switches, special controllers and related apparatus.

Complete engineering, sales and service facilities are available through 104 direct branch offices in the United States and Canada.

JOHNSON SERVICE COMPANY
507-P East Michigan Street, Milwaukee 1, Wisconsin

☐ Please have a Johnson engineer call on me.
☐ Send your condensed catalog of Johnson equipment.

Name_____ Title_____
Firm_____
Address_____
City & State_____

A fact for every electric utility

FROM COLD RESERVE TO FULL LOAD IN 60 SECONDS

Impossible? Not at all. For this is a characteristic of Electro-Mobile Power. From a cold start a 1000 kw unit can deliver its full load *in less than sixty seconds.*

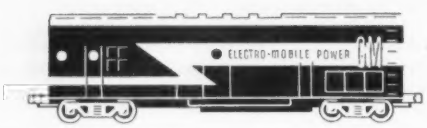
This is true of one or one-hundred units, 1000 kw or 100,000 kw—steady full-load power in far less time than required by any other prime mover, except a spinning unit.

But spinning reserve is *costly* reserve. By letting Electro-Mobile Power supply reserve requirements you not only eliminate running losses, but investment per kilowatt is lower. Efficiency of present stations will improve, too, because generators can be run at a higher load factor.

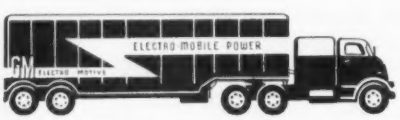
Further, by placing Electro-Mobile Power at the points of load, transmission loss is reduced and less reserve is required to maintain service. Another advantage: EMP units are available with impulse starting or stopping which permits unattended operation from any location.

How might a multi-megawatt system of Electro-Mobile Power units apply to your system? We'd like an opportunity to sit down with your engineers and discuss it. Contact your Electro-Motive representative, he has the details.

Increased demand of 5000 kw at central station picked up in less than 60 seconds by four 1000 kw Electro-Mobile units.

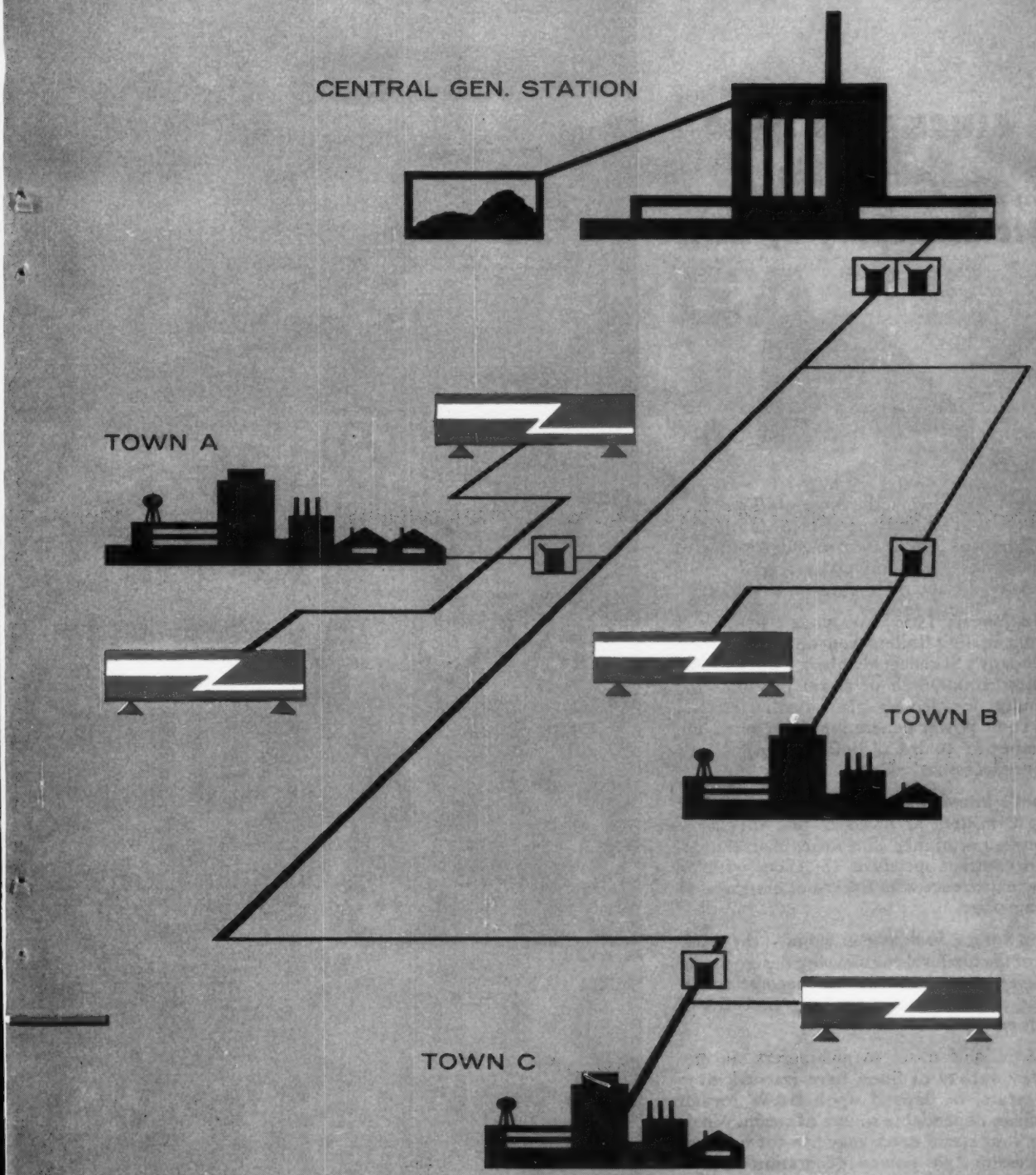


RAIL CAR—1000 kw units for use on sidings or placed on piers for semi-permanent use.



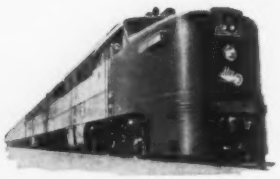
TRUCK TRAILER—500 kw units offer excellent mobility for many temporary applications.

This simple diagram suggests how Electro-Mobile Power located at points of load can effectively reduce reserve requirements and costs. Assuming a 1000 kw line loss at time of peak from the central station, only four 1000 kw EMP units are needed to pick up a 5000 kw demand. Naturally, line loss will vary according to the make-up of the system. However, an analysis of your peak line losses will show what savings can be expected.



ELECTRO-MOTIVE DIVISION
GENERAL MOTORS LA GRANGE, ILLINOIS
Sales Offices in Chicago, New York, St. Louis, San Francisco

SINCE 1888 ALCO
Has Said:
"Steam Supply by B&W"



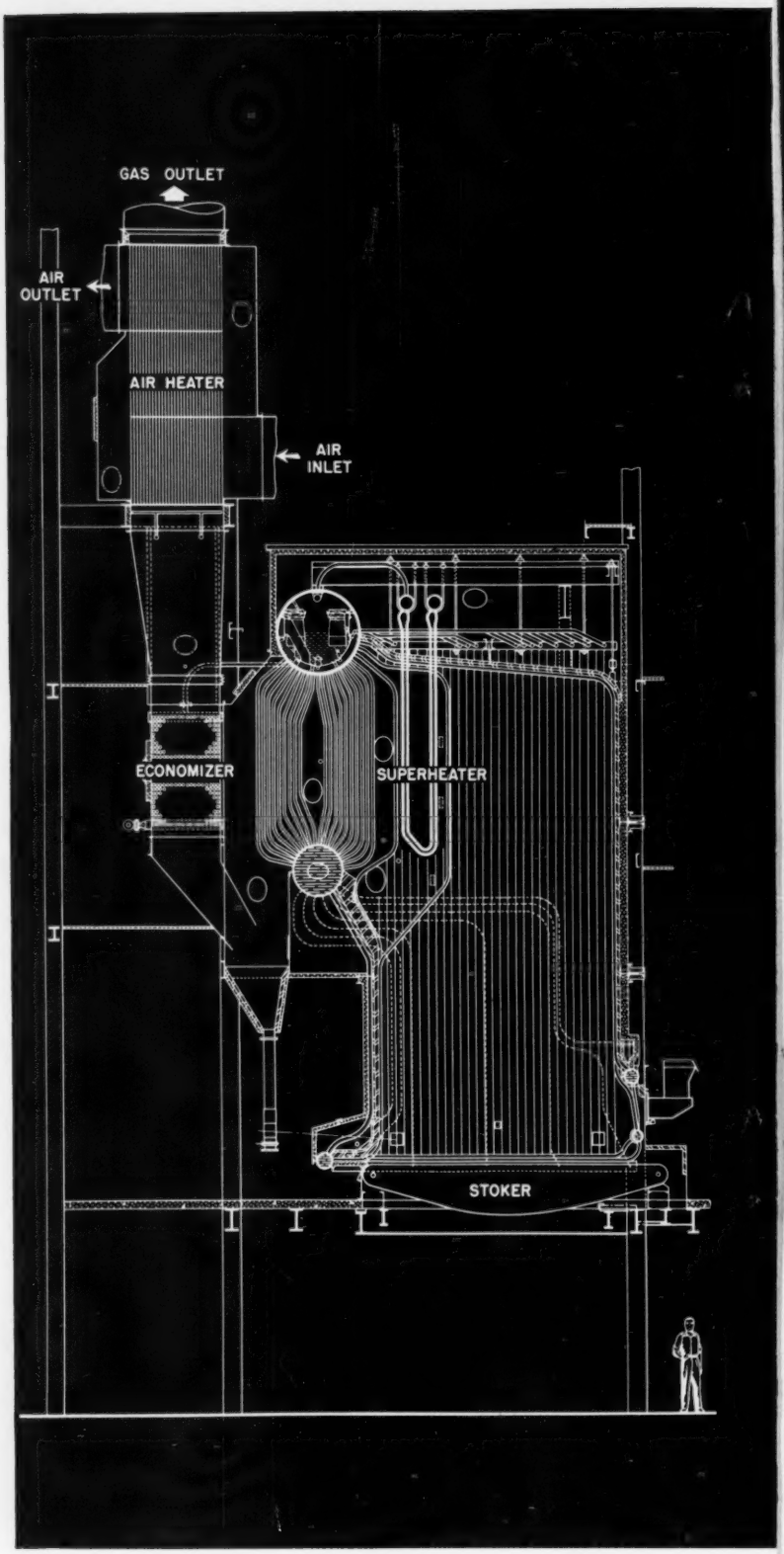
Back in 1888, when the *American Type* locomotive was setting speed records on passenger runs, B&W sold its first boiler to Schenectady Locomotive Works, predecessor of ALCO Products, Inc., to serve the plant.

In January 1955, two more B&W Two-Drum Stirling Boilers went on the line at the company's Schenectady plant. They are providing 100,000 lb of steam per hour for heating, for driving plant auxiliaries, and for some power generation. They bring the number to 40 B&W boilers in ALCO and its predecessors' plants.

What's Interesting about these two latest B&W boilers at ALCO is that they have operated at higher efficiencies than the design contract specified. To ALCO, with its long experience with B&W boilers, this was no surprise.

Long Range, Sustained economy—the product of the top level engineering design found in every B&W boiler—has become something to be expected by long time B&W customers.

More and more manufacturers, in the widest variety of lines, have learned, over the years, to depend upon B&W for an efficient, dependable source of steam. Whatever your steam needs may be—for heating, processing, or power generation—B&W engineers are ready to give you counsel, with nearly a century of steam generation experience behind them. The Babcock & Wilcox Company, Boiler Division, Dept. ME-2, 161 East 42nd St., New York 17, N. Y.



BABCOCK & WILCOX

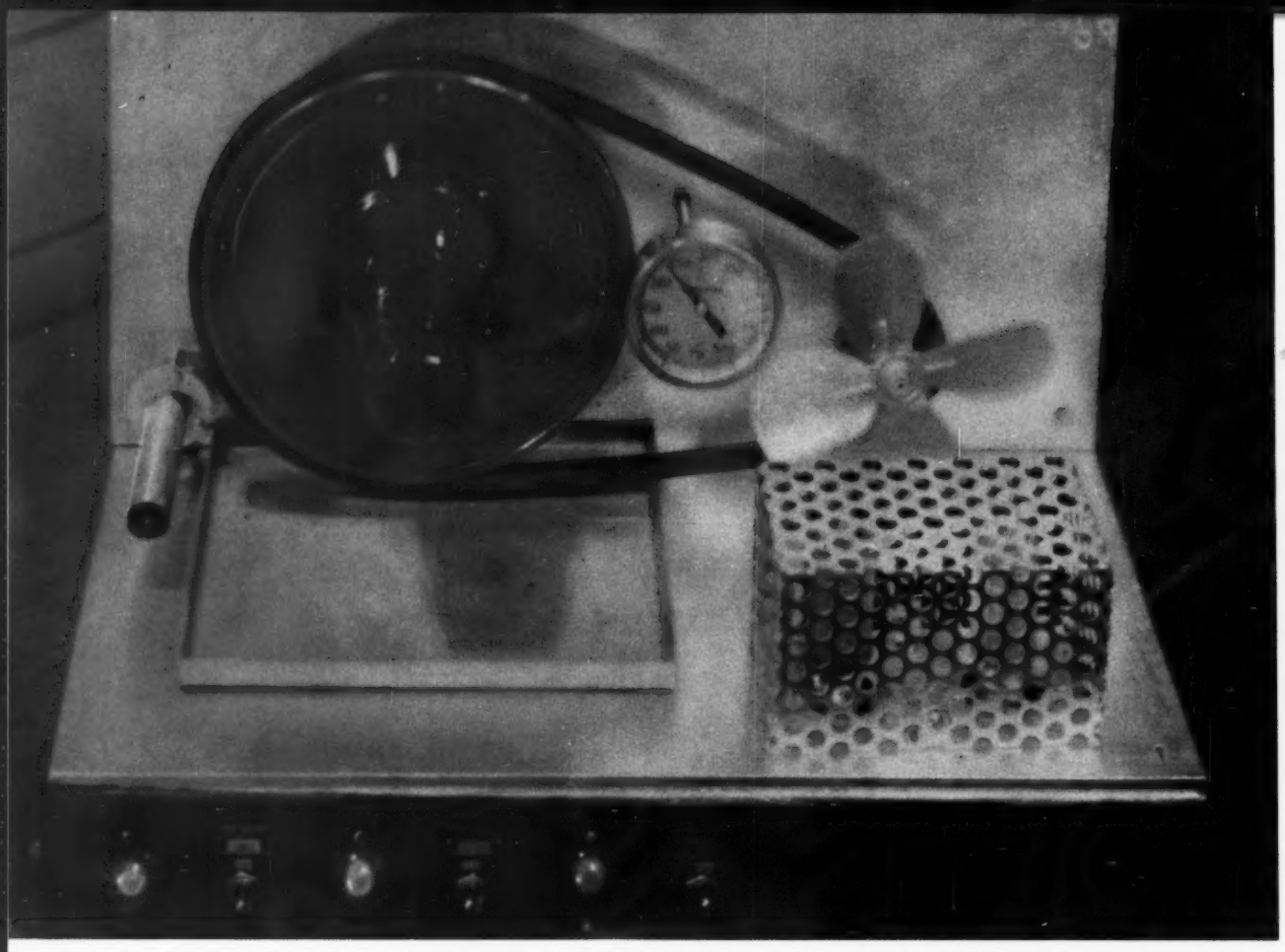
BOILER DIVISION

G-771

NEW GULFCROWN GREASE

... the improved lithium base multi-purpose grease

GULF



NEW

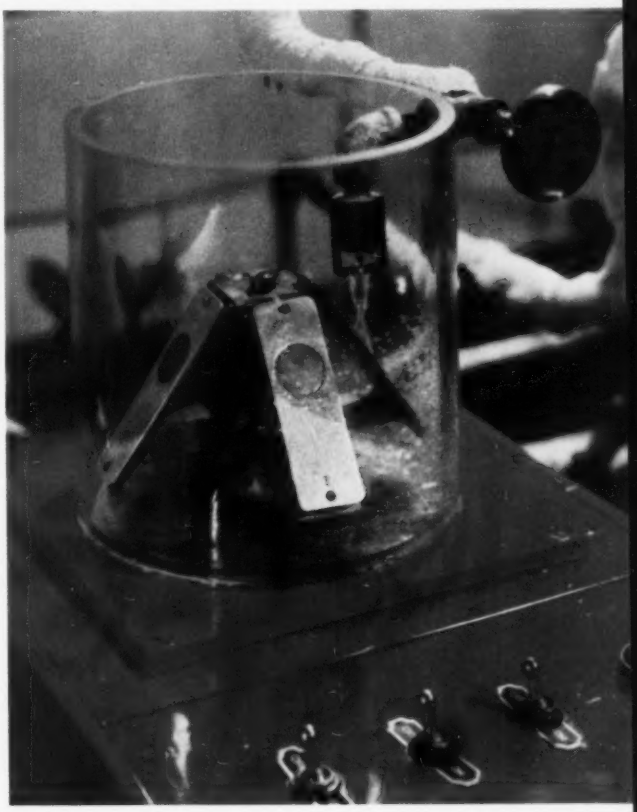
GULFCROWN

...the one grease that does the work of many

- Simplifies application and avoids errors
- Reduces inventory
- Cuts lubrication costs

This bearing packed with Gulfcrown Grease was run at 750 rpm in a special oven heated to 250°F. Gulfcrown "stays put" . . . doesn't run out even after thousands of hours at high operating temperatures. And the bearing remains in brand-new condition.

Samples of Gulfcrown (shown on 4 steel plates) are sprayed with water heated to 130°F. Note how Gulfcrown adheres, doesn't wash away.



Excellent oxidation stability

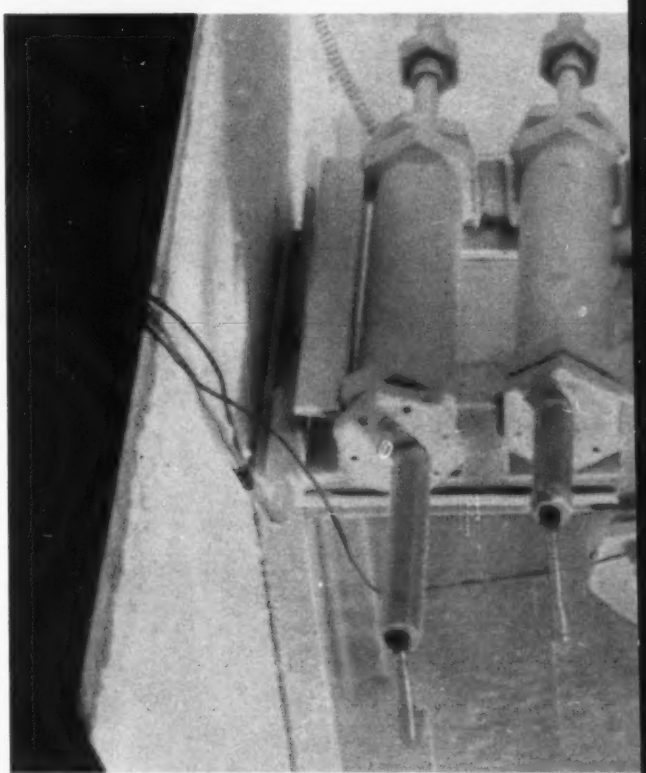
Gulfcrown is effectively inhibited against oxidation to insure long life, both in storage and in use.

Unsurpassed working stability

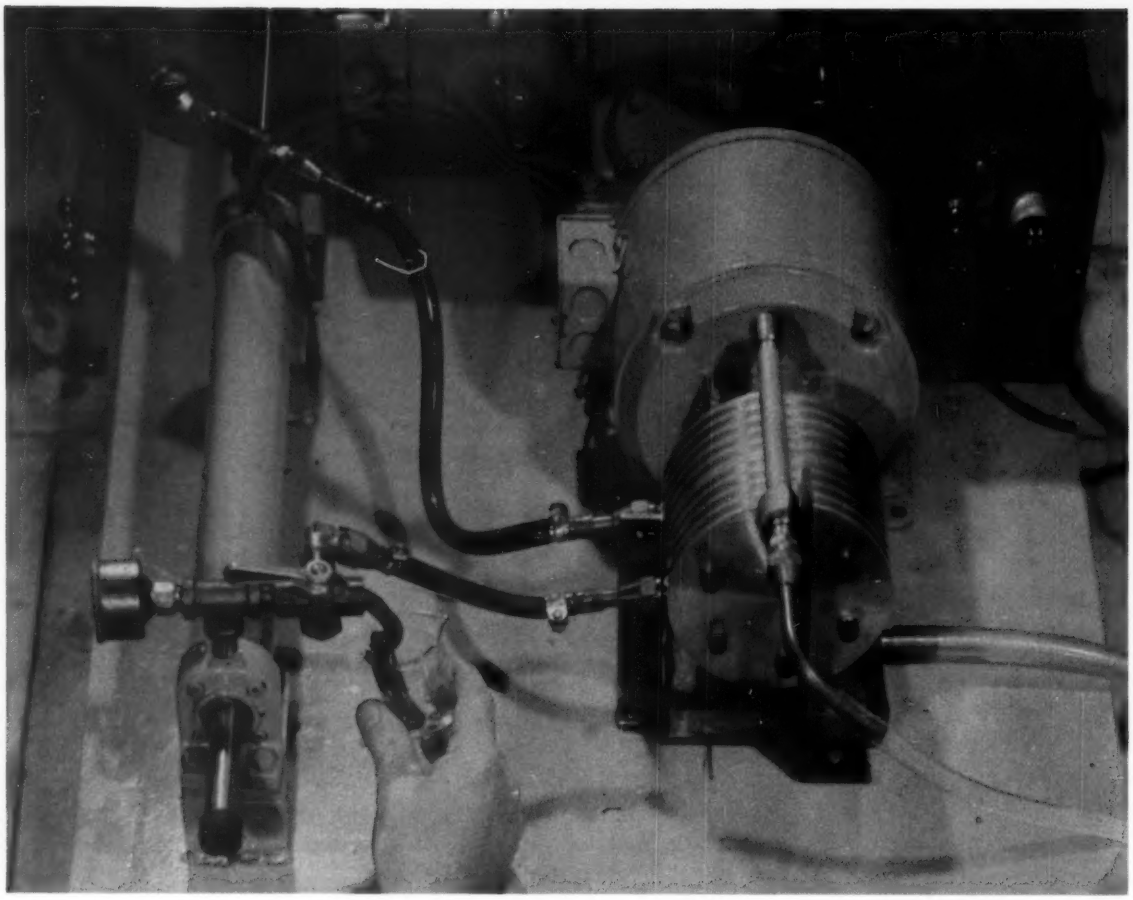
Gulfcrown Grease stands up under the churning action of high-speed bearings even at high temperatures. This means less grease consumption, less frequent applications. It is ideal for centralized grease systems—it pumps easily and will not separate.

Resists water

Gulfcrown Grease is highly resistant to the washing action of water. It provides excellent lubrication and protects against rusting even under the dampest conditions.



Gulfcrown Grease pumps easily even in coldest weather. Temperature in this freezer chest is 0°F.



This grease stability testing machine, developed at the Gulf Research Laboratory, provides additional evidence of the mechanical stability of Gulfcrown Grease. Gulfcrown does not break down in consistency even after being pumped through a bearing operating at 1725 rpm.

Gulfcrown is available in 4 consistencies. Your Gulf Sales Engineer will gladly help you make proper selection. Call him at your nearest Gulf office . . . or use the coupon below.

GULF

GULF OIL CORPORATION
1822 Gulf Building, Pittsburgh 30, Pa.

Gentlemen:

- ☐ Please send me free literature on new Gulfcrown.
- ☐ Please have a Gulf Sales Engineer call on me.

Name_____

Company_____

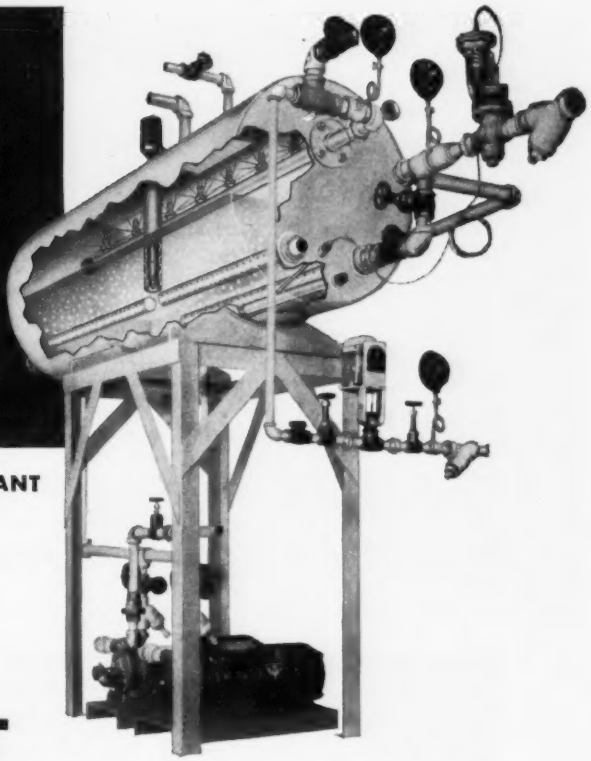
Title_____

Street_____

City_____ Zone_____ State_____

SP-8916

SCHAUB "03" DEAERATOR



FOR THE SMALL TO MEDIUM STEAM PLANT

- **Combats "Return Line" Corrosion**
- **Guarantees Oxygen Removal to .03 cc/liter**
- **Simpler in Principle and Operation**
- **Pays for Itself in Savings**

HOW TO CUT CORROSION COSTS

without Breaking Your Budget

If your steam needs are in the 3,000 to 30,000 lbs./hr. range the Schaub .03 Deaerator was designed with *you* in mind.

It is in plants of this size range — often operating at low pressure — that "return line" corrosion is most likely to be a continual costly maintenance item. A Schaub .03 Deaerator effectively combats this and at very low cost. It is equally applicable to high pressure installations.

The *big* difference between the Schaub .03 and other low-cost deaerators is that it operates *fully vented* at atmospheric pressure for better gas removal. Yet wasteful steam vapor loss is prevented regardless of load variations by the simple, but effective Schaub spray-contact vent condensing method. Other exclusive features that boost efficiency are pin-point temperature control and "live action" heating of storage water. This provides more forceful "break-away" of air molecules.

With fully vented design, no premium-cost pressure construction is needed and maintenance and operating costs are reduced to a minimum. Rust-proof Chromosoid lining adds years of trouble-free life.

NOTE: For boiler capacities up to 100,000 lbs./hr. and .005 cc/liter oxygen removal, write for Bulletin 575, describing the unique Schaub Zero-Oxygen Deaerator.

SEND FOR BULLETIN 1300

The full facts on the "hows", "whys" and basic differences in the Schaub .03 method. Filled with facts for the operating or consulting engineer responsible for boiler feedwater deaeration.

FRED H. SCHAUB ENGINEERING CO.

2105 South Marshall Boulevard • Chicago 23, Illinois

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Blvd., Chicago 23, Illinois

Please send me, without cost or obligation, my personal copy of your new Bulletin 1300 on Boiler Feedwater Deaeration.

Name_____

Company_____

Address_____

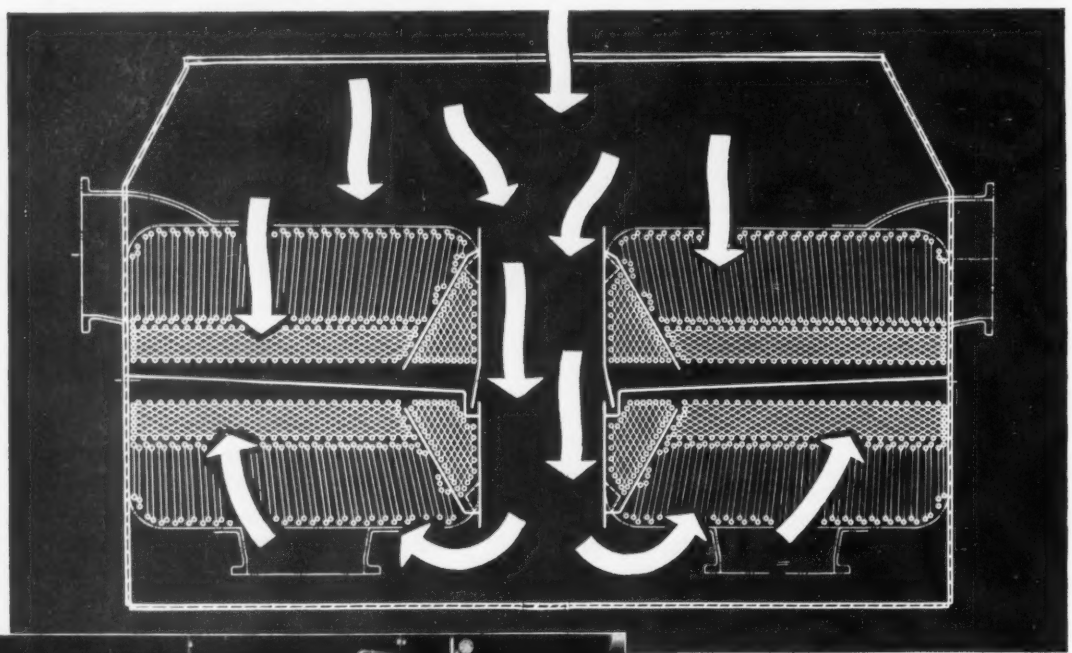
City_____ Zone_____ State_____

115 large Foster Wheeler

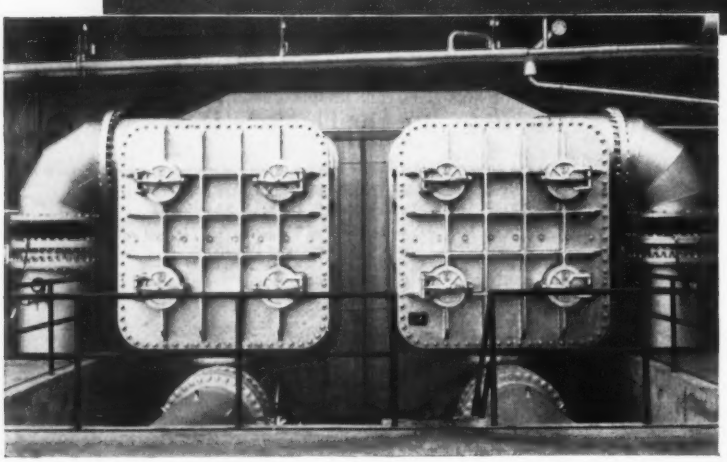
16 MILLION

Turbo-generator

Foster Wheeler has installed or is building Steam Surface Condensers for 115 turbo-generators of 100,000 kw capacity or larger, with a total output capability of over 16,000,000 kilowatts



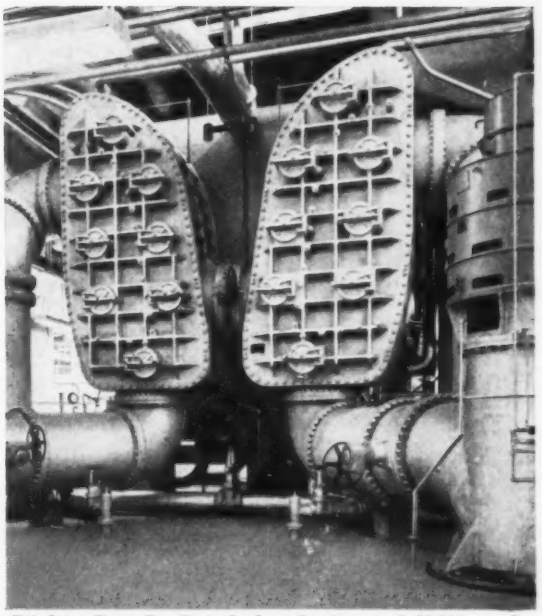
Transverse sectional elevation of FW double-flow, two-pass condenser, for installations requiring minimum headroom.



FW Double-Flow Surface Condenser of 70,000 sq. ft., serving a 100,000 kw turbo-generator at the L. V. Sutton Station, Carolina Power & Light Co.

Condensers for KW Capacity

THE NUMBER of large Foster Wheeler Surface Condensers now installed or on order — and the total kw capacity of the generators which they serve — is an indication of their outstanding acceptance by the power industry. This, together with the high percentage of repeat orders, reflects the dependability and long-term economy of Foster Wheeler condensers, as demonstrated by on-the-job performance in leading power plants from coast to coast. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*



FW Cross-Flow, Two-Pass Surface Condenser of 87,000 sq. ft., serving a 125,000 kw turbo-generator at the Barry Station, Alabama Power Co.

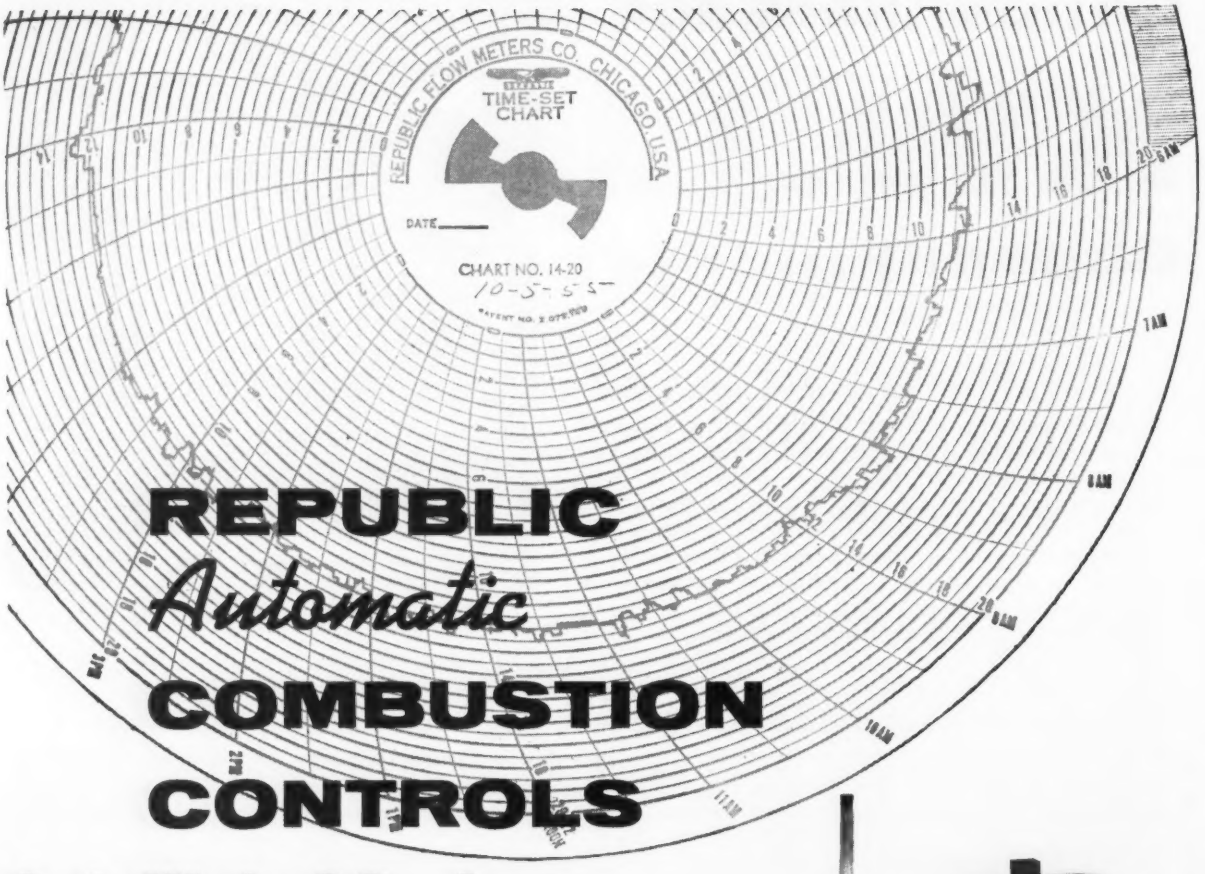
FW CONDENSERS SERVING TURBINES OF 100,000 KW OR MORE

CUSTOMER	STATION	No. of Units	CUSTOMER	STATION	No. of Units
Alabama Power Company	Gorgas Station	5	Louisville Gas & Electric Co.	Cane Run Station	3
Alabama Power Company	Barry Station	2	Mississippi Power & Light Co.	Rex Brown Steam Plant	1
Aluminum Company of America	Sandow Plant	3	New Orleans Public Service, Inc.	Michoud Steam Plant	1
Aluminum Company of America	Warrick Plant	3	Omaha Public Power District	North Omaha Plant	2
American Gas & Electric for Ohio Power Co.	Tidd Station	1	Oklahoma Gas & Electric Co.	Riverbank Station	1
Arkansas Power & Light Co.	Cecil Lynch Station	1	Oklahoma Gas & Electric Co.	Horseshoe Lake Station	1
Arkansas Power & Light Co.	Harvey Couch Station	1	Oklahoma Gas & Electric Co.	Mustang Station	1
Carolina Power & Light	L.V. Sutton Station	1	Pacific Gas & Electric Co.	Station "P"	2
Carolina Power & Light	Cape Fear Station	2	Pacific Gas & Electric Co.	Moss Landing Station	5
Central Hudson Gas & Electric Corp.	Danskammer Point	1	Pacific Gas & Electric Co.	Contra Costa Station	2
Central Illinois Public Service Co.	Grand Tower Plant	1	Pacific Gas & Electric Co.	Pittsburg Plant	4
Central Nebraska Pub. Power & Irr. Dist.	Canaday St. Plant	1	Philadelphia Electric Co.	Southwark Station	2
Commonwealth Edison Company	Crawford Station	1	Public Service Co. of Indiana, Inc.	Wabash Station	4
Commonwealth Edison Company	Joliet Station	1	Public Service Electric & Gas Co. of New Jersey	Marion Station	1
Consumer's Power Co.	Weadock Station	1	Public Service Electric & Gas Co. of New Jersey	Sewaren Station	4
Consumer's Power Co.	B.C. Cobb Station	1	Public Service Electric & Gas Co. of New Jersey	Kearny Station	2
Consumer's Power Co.	Dan E. Karn Station	1	Public Service Electric & Gas Co. of New Jersey	Linden Station	2
Dallas Power & Light Co.	Parkdale Station	1	Public Service Electric & Gas Co. of New Jersey	(undisclosed)	1
Dallas Power & Light Co.	Mountain Creek Station	1	Super Power Co. of Illinois	Powerton Station	2
Florida Power Corporation	Paul Bartow Station	1	Tennessee Valley Authority	Widows Creek Steam Plant	6
Florida Power & Light Co.	Fort Lauderdale Plant	2	Tennessee Valley Authority	Shawnee Steam Plant	10
Florida Power & Light Co.	Fort Myers Plant	1	Tennessee Valley Authority	Colbert Station	4
Florida Power & Light Co.	Site unsettled	1	Texas Electric Service Co.	Graham Station	1
Georgia Power Co.	Plant Yates	3	Texas Power & Light Co.	Morgan Creek Station	1
Houston Lighting & Power Co.	Sam Bertron Station	3	Tokyo Electric Co.	Chiba Station	1
Houston Lighting & Power Co.	Smithers Lake Station	2	Union d'Electricite, Paris	Genevillers Power Station	1
*Hydro-Electric Power Commission of Ontario	Richard L. Hearn Generating Station	1	United Illuminating Company	Bridgeport Station	1
Kansas City Power & Light Co.	Hawthorne Station	1			
Kansas Gas & Electric Co.	Murray Gill Station	2			
Louisiana Power & Light Co.	Sterlington Station	1			

**Foster Wheeler Ltd., St. Catharines, Ontario*

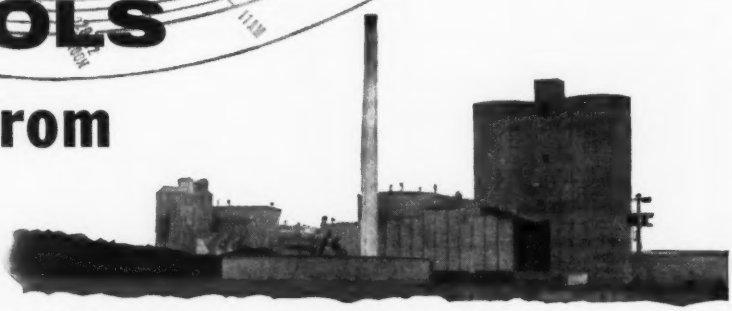
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.



REPUBLIC *Automatic* COMBUSTION CONTROLS

Get High CO_2 from Low Grade Coal



at UTAH-IDAHO SUGAR COMPANY'S NEW $7,000,000 PLANT

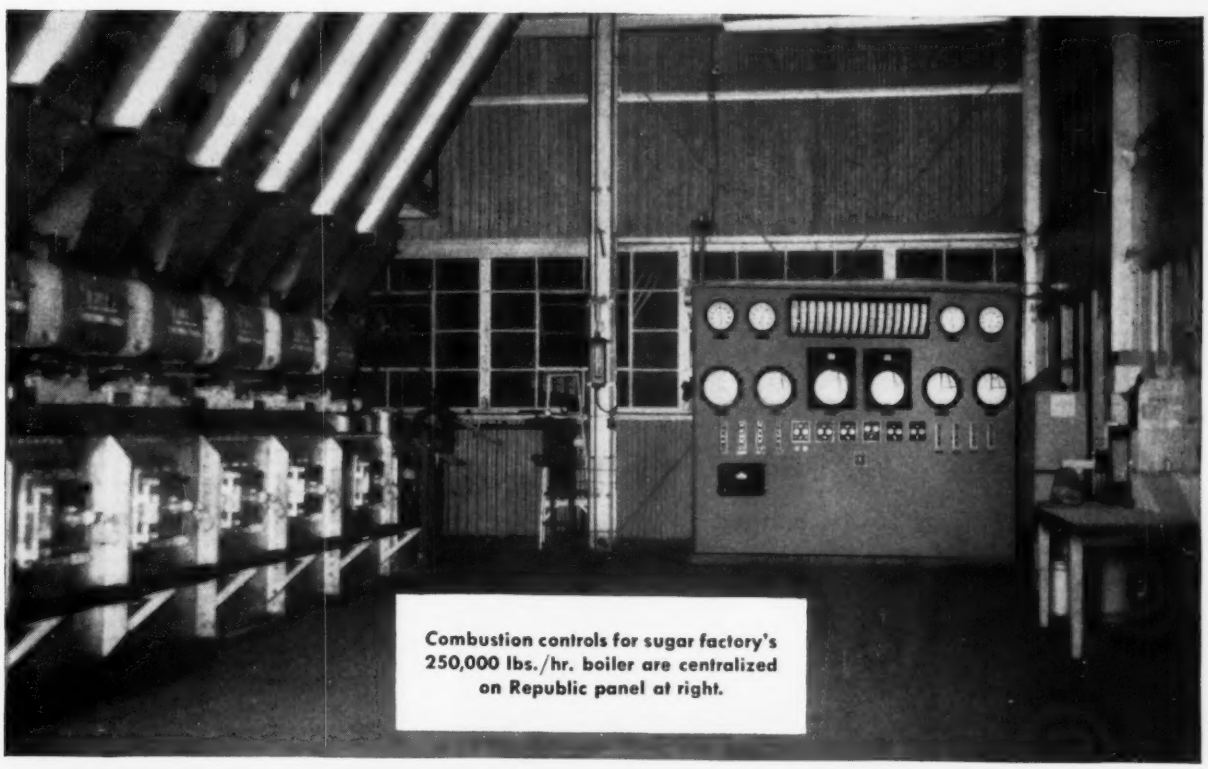
In any power plant, the percentage of CO_2 in combustion gases is indicative of combustion efficiency. But at the power plant for Utah-Idaho Sugar Company's new sugar beet factory, Moses Lake, Washington, a good CO_2 performance record is more than desirable. It's actually essential! That's because the plant supplies not only steam, but CO_2 as well to sugar-making processes. The CO_2 is extracted from combustion gases and becomes a vital ingredient in the production of over 75,000,000 lbs. of sugar and thousands of tons of molasses the factory produces annually. With the plant limited to low grade western coal, continuous maximum combustion efficiency at all loads is necessary to insure adequate CO_2 for processes.

Republic Automatic Combustion Controls enable the plant's spread stoker fired 250,000 lbs./hr. boiler

operating at 400 psig and 575°F. to meet CO_2 requirements while matching steam supply to process demands. Daily CO_2 charts indicate the boiler is consistently producing 12–13% CO_2 in spite of the quality of coal burned.

According to operators, ash removal, cleaning of the fire and soot blowing can be carried out with the combustion controls on automatic without disturbing the fuel-air ratio. Furnace draft is controlled satisfactorily despite the high stack on the plant. Turbine drives on forced and induced draft fans are speed controlled by the combustion controls, eliminating the need for dampers. A three element Republic boiler feedwater system is also tied in with the combustion control system to automatically supply the proper amount of water to the boiler at all steaming rates.

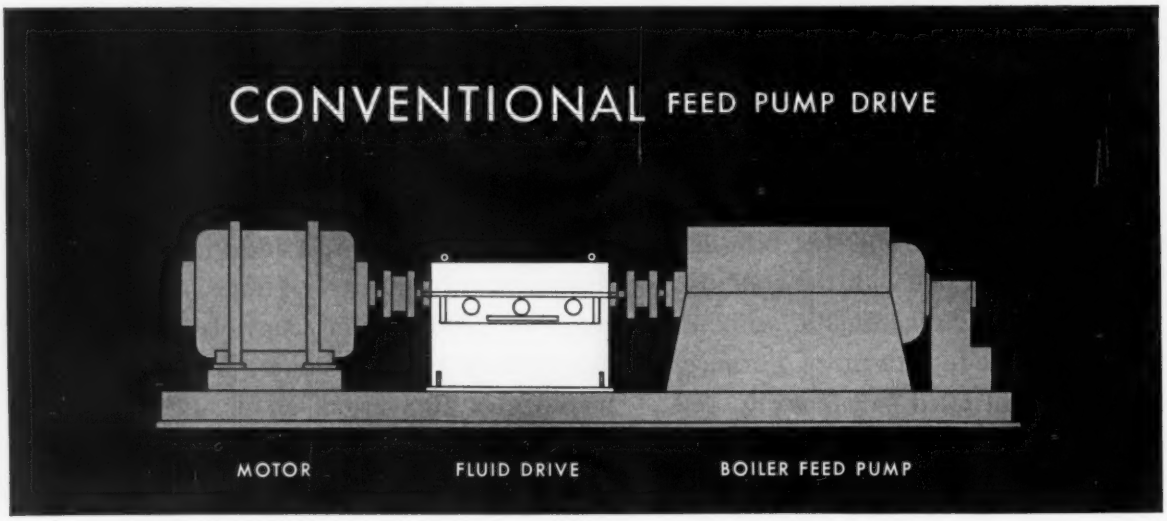
This plant is one more example of how Republic combustion engineers design control systems that enable boilers to exactly meet individual plant requirements. There are Republic Combustion Controls for any size or type of boiler, for all methods of fuel firing, all arrangements of draft and all load conditions. When you want to be sure of getting maximum boiler performance, ask Republic to design and build your combustion control system.

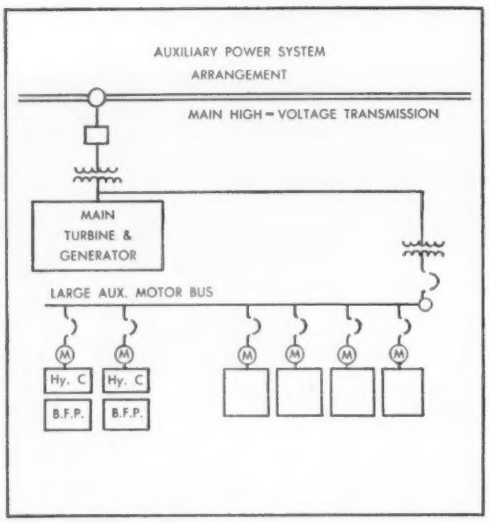


Combustion controls for sugar factory's 250,000 lbs./hr. boiler are centralized on Republic panel at right.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

How *Gýrol*® Fluid Drive meets all

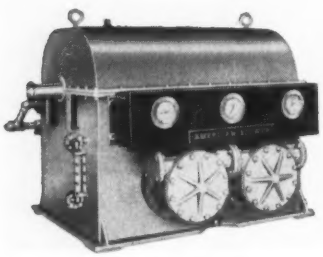




Of all power-plant auxiliaries, the boiler feed pump consumes the greatest single segment of invested power. To release more of this power to consumer lines, power plants of all sizes are controlling feed water flow by speed regulation through Gýrol Fluid Drive – driven by a constant speed prime mover.

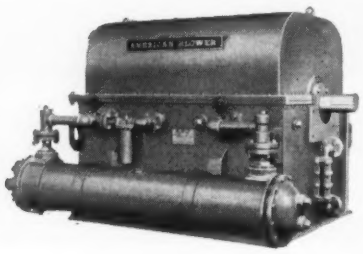
Gýrol Fluid Drive offers several specific advantages:

1. It saves power over the entire operating range by eliminating wasteful throttling by valves.
2. Fluid Drive's adjustable-speed feature permits reduction in pressure – resulting in further power savings.
3. It reduces wear on bearings, and other vital pump parts, by letting the pump operate at speeds that fit boiler demands.
4. With Fluid Drive, paralleling of pumps is simplified. Change-over from operating to standby pump is quick and easy.
5. Quiet operation is inherent in the design of Fluid Drive, since a "cushion of oil" is the means of energy transmission.



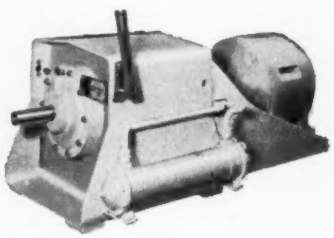
TYPE VS CLASS 6

- adjustable speed control
- 250 to 12,000 horsepower
- speeds to 3600 rpm



TYPE VS CLASS 4

- adjustable speed control
- 100 to 2500 horsepower
- speeds to 1800 rpm

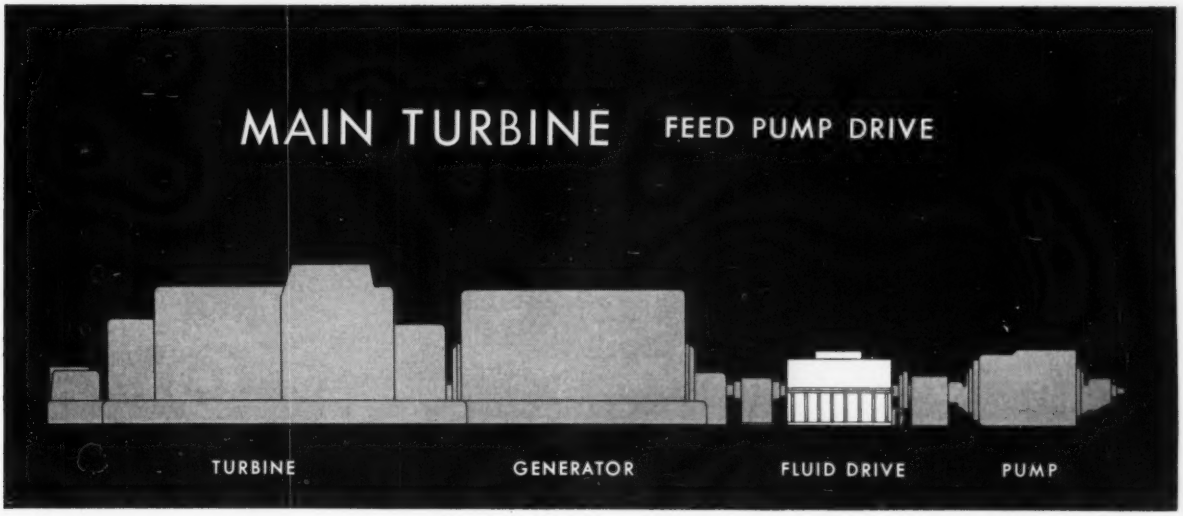


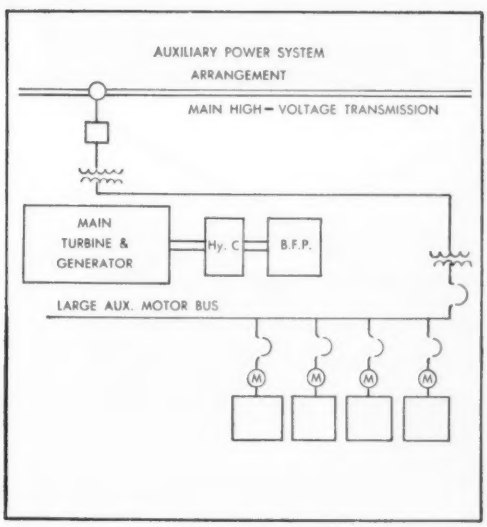
TYPE VS CLASS 2

- adjustable speed control
- 1 to 800 horsepower
- speeds to 1800 rpm

requirements for feed pump control

Regardless of station size, arrangement, or prime mover, you get the advantages of power savings, reduced pressures, and quiet operation with American Blower Gýrol Fluid Drives





Already in the construction stage is the use of Gýrol Fluid Drive for main turbine feed pump drives on some of the largest generating units yet projected.

For example, two of these stations will each drive, through a 12,000-hp adjustable-speed Gýrol Fluid Drive, the main feed pump from the high-pressure turbine. Full boiler capacities will be supplied by the single 5-stage pump, each delivering 6330 gpm against 6400 feet total discharge head when operating at 3510 rpm with feed water at 363° F.

Each pump requires an excess of 11,000 hp, and will be driven from the generator shaft through an adjustable-speed Gýrol Fluid Drive.

In your plans for expansion, why not discuss the advantages of Gýrol Fluid Drive with an American Blower engineer. His knowledge of this application in modern power plants may prove valuable to you. Call our nearest branch, or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

AMERICAN BLOWER

Division of American-Standard

BURLINGTON, VT. ELECTRIC LIGHT 100,000 LBS. PER HOUR WICKES IN THE NEW POWER PLANT

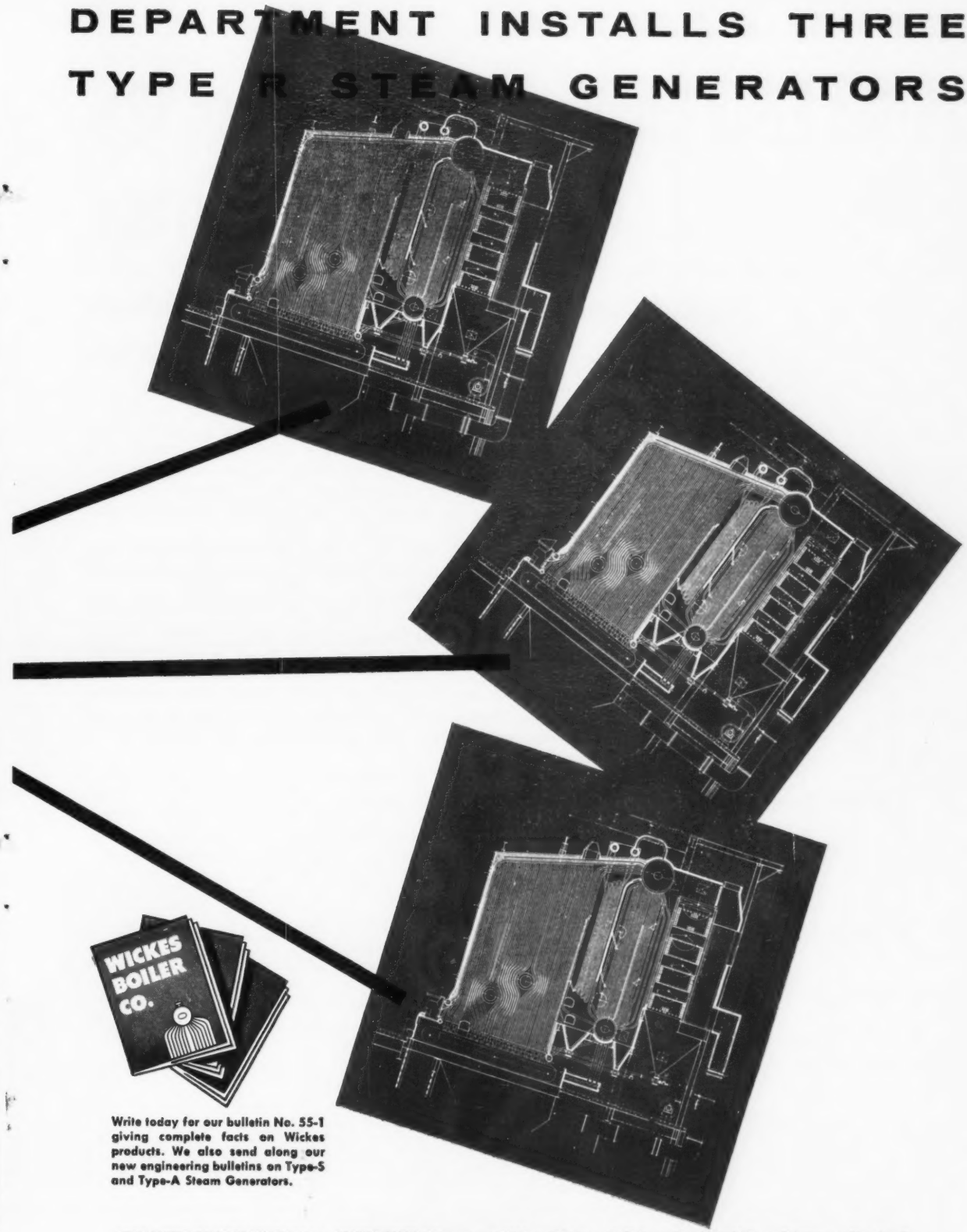
At the modern plant of the Burlington, Vermont Electric Department, three Wickes type R steam generators provide a powerful and unfailing steam supply. Each unit delivers 100,000 pounds of steam per hour, contains 7480 square feet of boiler heating surface, and 2320 square feet of water wall heating surface. Each steam generator is equipped with a superheater, airheater and economizer. These boilers have a design pressure of 1000 psi. This modern plant is operated by the Green Mountain Power Corporation. Superintendent of Burlington's Electric Light Department is W. A. Stebbins.

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION

SAGINAW, MICHIGAN

DEPARTMENT INSTALLS THREE TYPE R STEAM GENERATORS



Write today for our bulletin No. 55-1 giving complete facts on Wickes products. We also send along our new engineering bulletins on Type-S and Type-A Steam Generators.

RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* Albuquerque, N.M. • Boston • Buffalo • Charlotte, N.C. • Chicago • Cleveland Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D.C.

164

Station Load changes from 100% to 12%

...ON AUTOMATIC CONTROL

Hagan Automatic Systems help keep Niagara Mohawk Albany Station on frequency control

A new station seldom encounters as drastic load changes as Niagara Mohawk's Albany Station. At the end of a chain of water power stations, it has the job of taking up the slack as water level and power demand varies. During the spring season, it may swing from 50 MW at night to its maximum rated output of 400 MW during the day. No matter how low the load falls, the station stays on automatic.

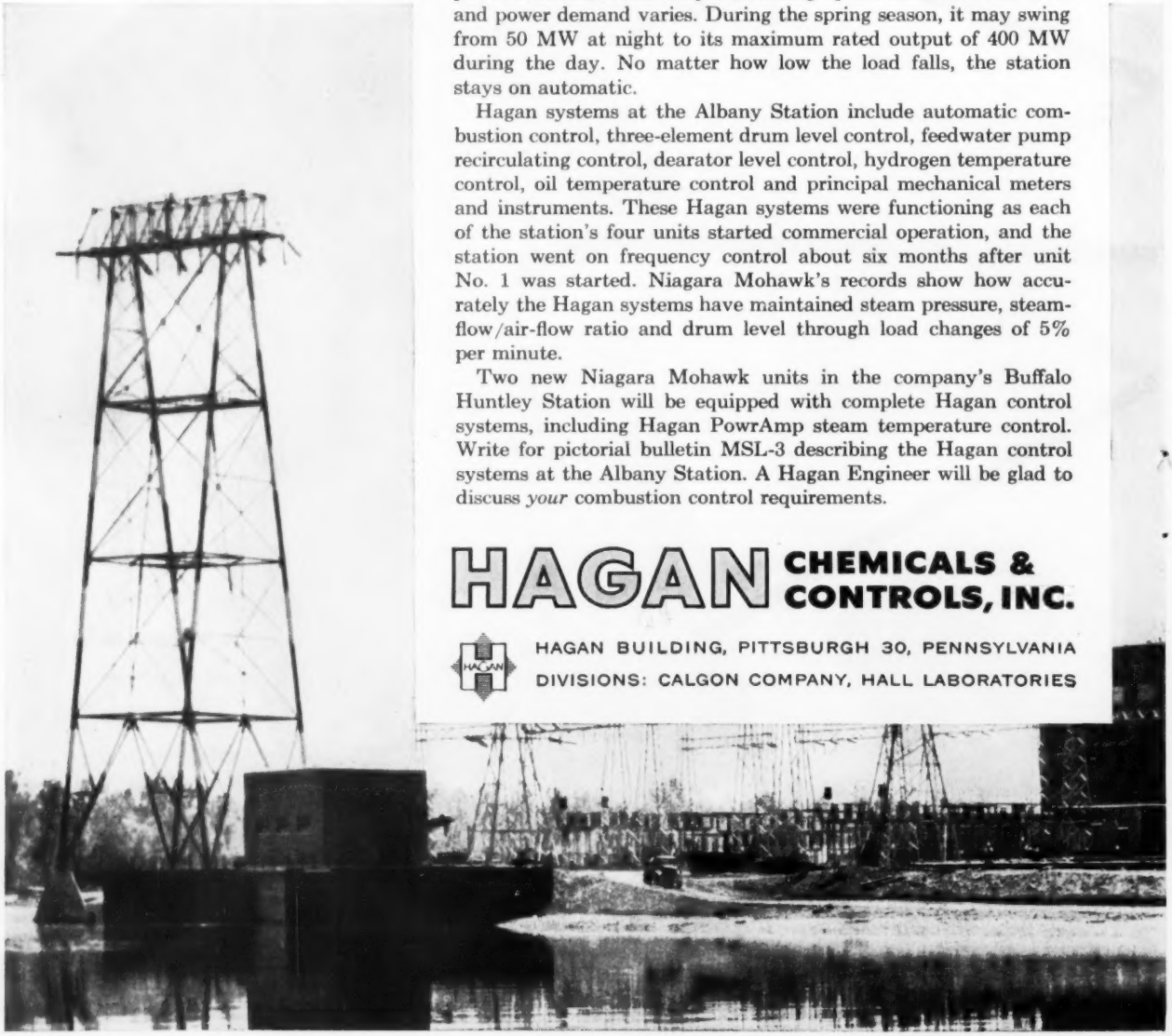
Hagan systems at the Albany Station include automatic combustion control, three-element drum level control, feedwater pump recirculating control, dearator level control, hydrogen temperature control, oil temperature control and principal mechanical meters and instruments. These Hagan systems were functioning as each of the station's four units started commercial operation, and the station went on frequency control about six months after unit No. 1 was started. Niagara Mohawk's records show how accurately the Hagan systems have maintained steam pressure, steam-flow/air-flow ratio and drum level through load changes of 5% per minute.

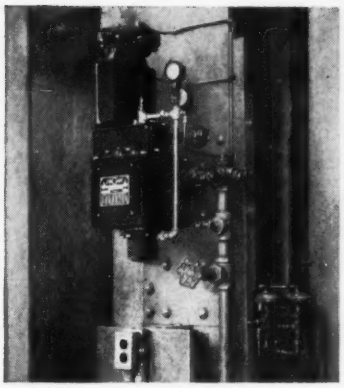
Two new Niagara Mohawk units in the company's Buffalo Huntley Station will be equipped with complete Hagan control systems, including Hagan PowrAmp steam temperature control. Write for pictorial bulletin MSL-3 describing the Hagan control systems at the Albany Station. A Hagan Engineer will be glad to discuss *your* combustion control requirements.

HAGAN CHEMICALS & CONTROLS, INC.

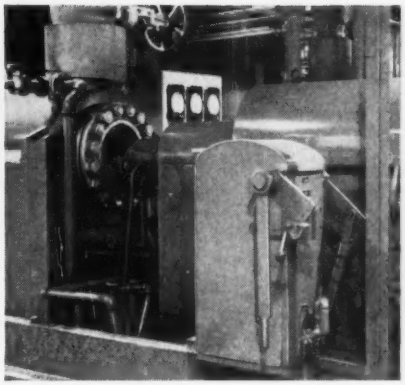
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

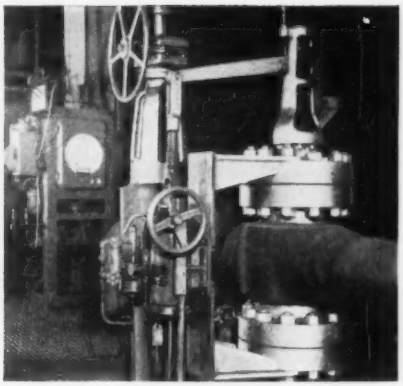




Hagan Furnace Pressure Regulator. This installation is equipped with the Hagan remote switching system, eliminating the lag normally present in long-line pneumatic systems. Controlling the Forced Draft Fan inlets, this Hagan Regulator is a unique instrument. Instant response, high stability and wide range adjustment makes the Hagan Regulator easy to tailor to a specific application.

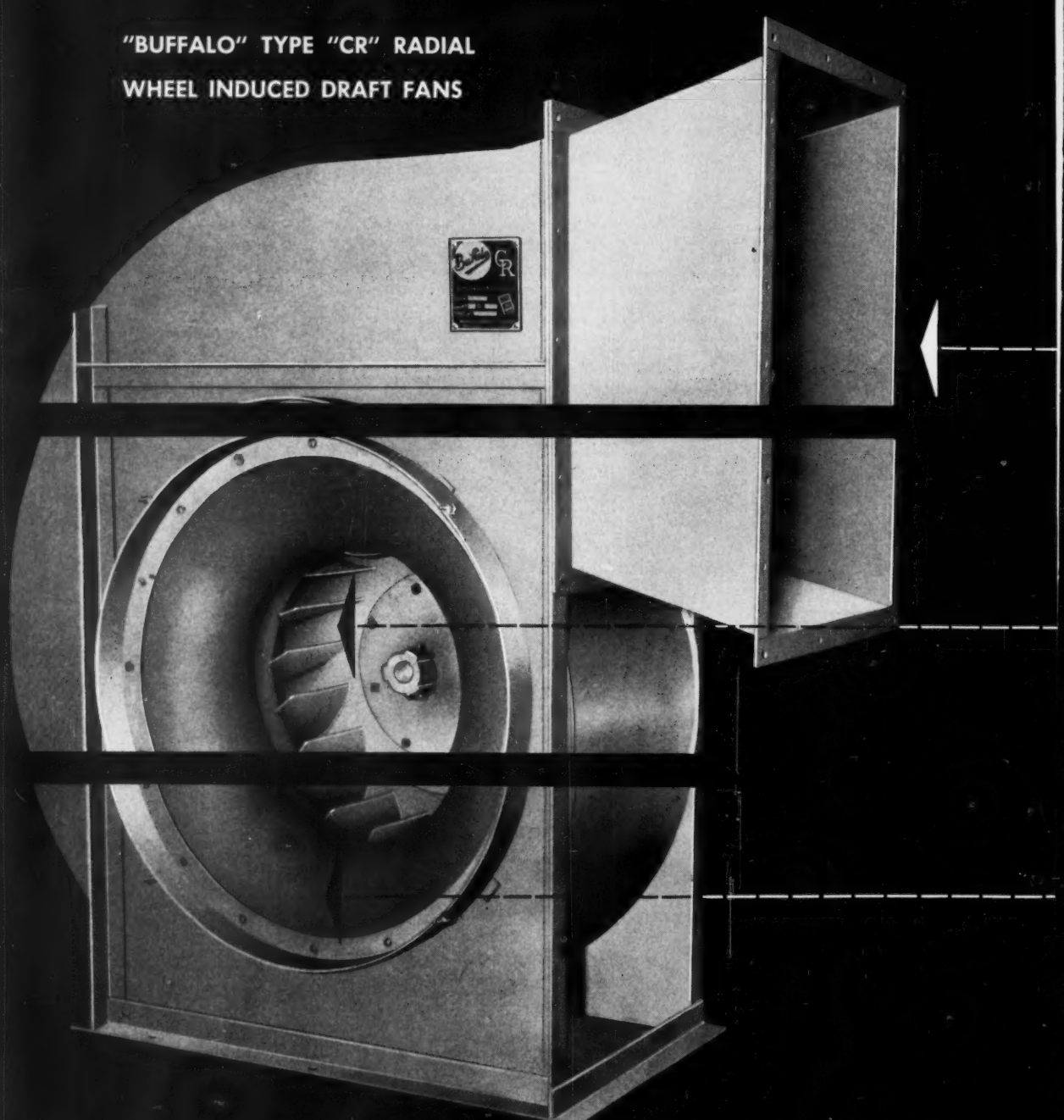


Boiler Feed Pump Hydraulic Coupling Control. Here a 6 x 10 Hagan Power Positioner implements the signal from the feed water control. This Power Positioner is one of a full range of sizes suitable for many positioning applications. Hagan Power Positioners are fast and accurate, with dependable repeatability. The panel in the background contains Hagan Ring Balance meters which record the three separate flows, totalize each flow and record the total of all three.



This 5 x 10 Hagan Power Positioner positions the feedwater control valve. Normally on standby, this valve is an alternate means of feedwater control. The Hagan Ring Balance Meter in the background transmits boiler drum water level, compensated for changes in density. This provides reliable and accurate drum level reading from atmospheric pressure to full operating pressure when going on or off the line. For details on this unique system, ask for Bulletin MSA-117.

"BUFFALO" TYPE "CR" RADIAL WHEEL INDUCED DRAFT FANS



Radial Wheel Fans are just one of a complete series of "Buffalo" Draft Fans covering the full range of varying boiler requirements. Whether you are interested in extremely high efficiency — fan size or first cost, "Buffalo" can offer you the best selection — with no compromise. Contact the "Buffalo" Engineering Representative nearest you, or write us about your requirements today!

ARE THESE THE FAN CHARACTERISTICS TO MEET YOUR INDUCED DRAFT REQUIREMENTS?

● **DIVERGENT OUTLET IMPROVES STATIC CONVERSION** — Providing a gradual change from velocity at the fan cutoff to static pressure in the duct, this unique "Buffalo" feature eliminates a common source of turbulence in fans. From inlet to outlet, such complete streamlining has produced a new high in efficiency. At the same time, it has minimized abrasive effects in every part of the fan.

● **3 WHEELS TO CHOOSE FROM** for varying characteristics within the "Buffalo" Radial blade type of fan. Besides the type "CR", two other types may be selected for different volume and pressure characteristics. Note the deeply pressed curved flange for smooth air flow and rigidity. The blades are radial at the tip, curving smoothly forward at the inlet.

● **SMOOTH CURVED INLET PATH** formed by inlet bell and matching wheel flange minimizes both turbulence and abrasive effect. The "CR" is the only fan of its kind designed for either open inlet or variable inlet vanes — and is therefore an excellent choice for inlet volume control. "Buffalo" cantilevered inlet vanes do not reduce the high performance of this fan.

● **HIGH VOLUME, HIGH PRESSURE** — This characteristic of the "Buffalo" Type "CR" Fan not only makes it desirable for many induced draft applications — but often makes possible selection of a smaller size on certain direct drive installations, for lower first cost.

● **RESISTANCE TO ABRASION** — This has made the "CR" popular on coal-fired boilers and other abrasive jobs. Available with wearing strips for the most severe conditions, though complete streamlining makes it inherently resistant to abrasion.

● **OVER 78% MECHANICAL EFFICIENCY OVER A WIDE RANGE** — a very favorable balance of performance with low first cost and low operating cost. (Where efficiency is the principal consideration, your choice might be a "Buffalo" Airfoil or Backward Curve Fan.)

● **LONG LIFE UNDER SEVERE SERVICE** — In addition to inherent resistance to abrasion, the "CR" has the typically heavy-duty, rigid construction of all "Buffalo" Draft Fans — heavy plate housing and blades, oversize shafts and bearings.

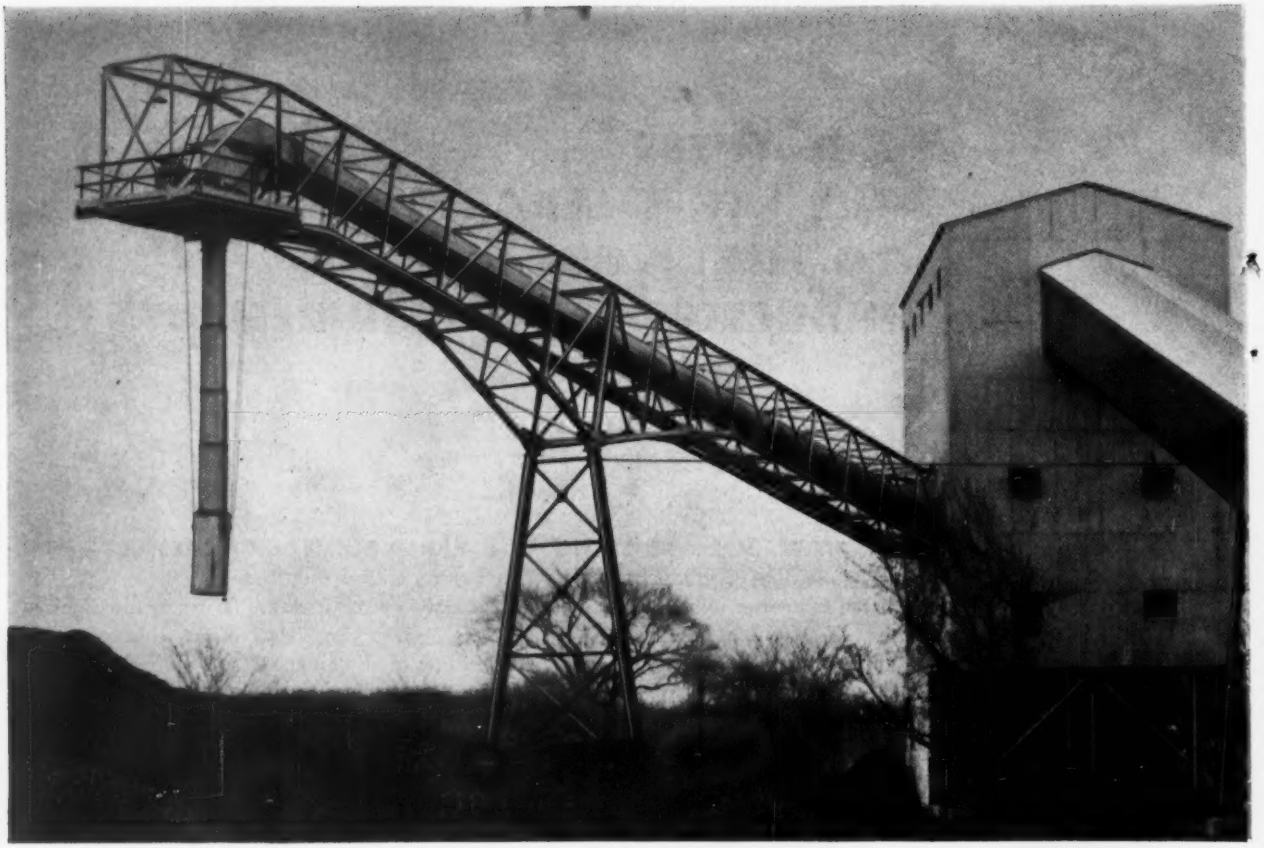
**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life in every "Buffalo" product.*

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING



A section of a 300 TPH belt conveyor system at a midwest power station. Design permits future expansion which will double present capacity.

STEPHENS-

the name to call on for mechanized

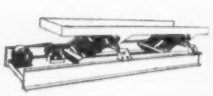
Moving coal from a receiving point to combustion at lowest possible cost is a vital problem in central power stations, private industrial plants, service institutions —wherever coal is used for steam generation.

The trick in the moving is knowing how to apply modern, scientific conveying equipment to any given set of conditions. How will coal arrive at the plant? What are generation requirements? What specific types of handling equipment are needed? What are storage needs inside and out? STEPHENS-ADAMSON engineers probe the problem all the way. These same men know there is no such thing as a "typical" power plant conveyor system. It must be designed purely to meet existing conditions and with plenty of foresight for future demand.

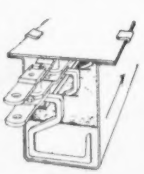
To provide the tools the engineer needs, STEPHENS-ADAMSON manufactures a complete line of coal handling equipment. It is a quality line designed from long experience, built to last for years of trouble free service.

For the ultimate economy in coal handling systems, see the STEPHENS-ADAMSON representative in your area. Learn why it pays to convey the S-A way.

BELT CONVEYORS



VIBRATING CONVEYORS

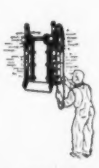


REDLER CONVEYORS, ELEVATORS

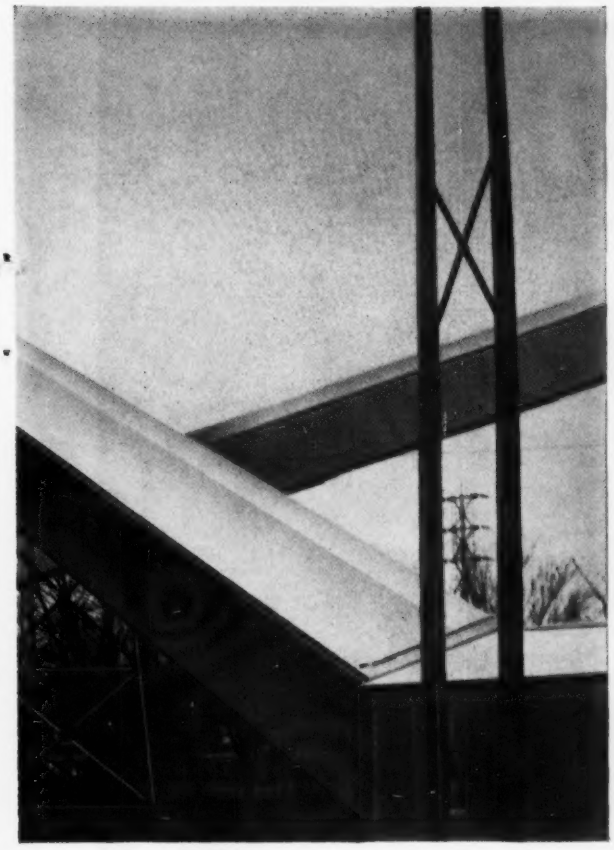
ZIPPER CONVEYOR-ELEVATORS

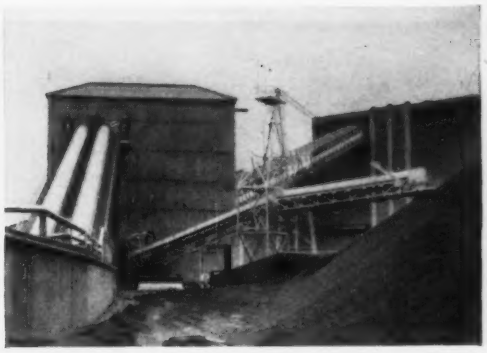
PAN CONVEYORS

BUCKET ELEVATORS



BIN GATES—ALL KINDS





An S-A system serves the needs of the Potomac Electric Power Co., Washington, D.C. Existing facilities have been designed with provision for ultimate 493,000 KW output.

Brantly Steam Station, Danville, Va., is served by an S-A conveyor system. Compact REDLER conveyor-elevators are used to good advantage to convey coal to silo and stockpile storage. A pan feeder serves to move coal from track hopper and also reclaims from storage pile.

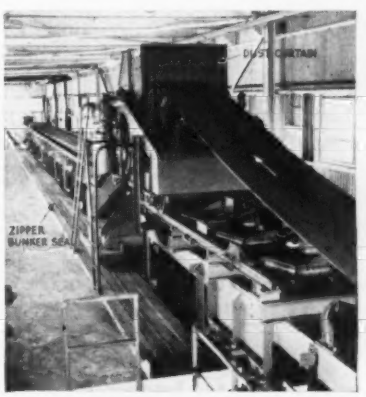
-ADAMSON

economy in coal conveyor systems

S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

Belt Conveyors	Headshaft Holdbacks
Belt, Pan & Plate Feeders	Grizzlies & Screens
Ship Loading Boom Conveyors	Centrifugal Pilers
Stacking Conveyors	Bin Gates & Tunnel Gates
Storage & Reclaiming Systems	Car Pullers & Spotters
"Natural Frequency" Vibrating Conveyors	Bucket Elevators
REDLER Conveyor-Elevators	Skip Hoists
ZIPPER Conveyor-Elevators	SEALMASTER Ball Bearing
Conveyor Belt Cleaners	Units

• *Write for a bulletin on any of the above products.*

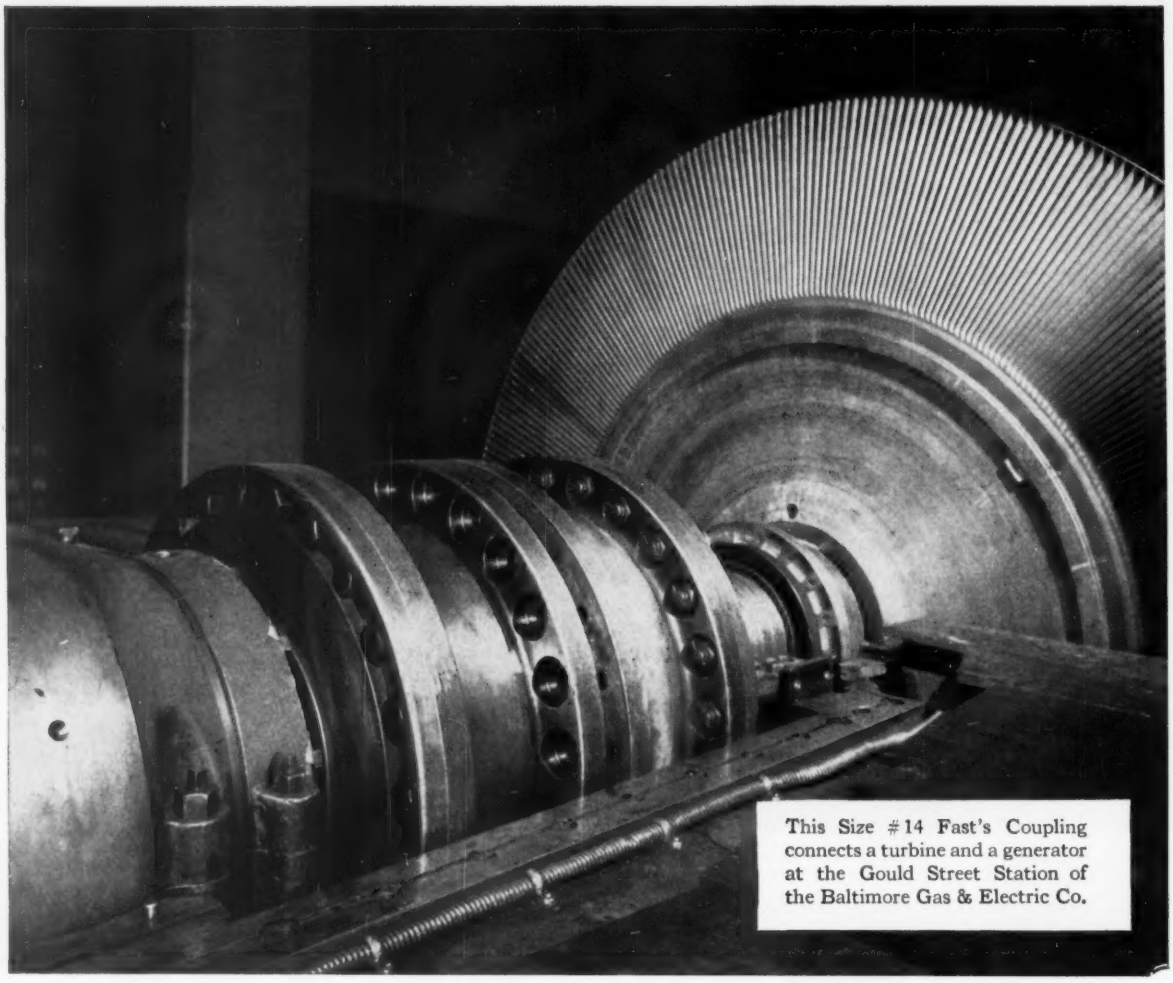


A self-propelled tripper is used by the Carolina Power and Light Company, Wilmington, N.C., to discharge coal from a belt conveyor into a zipper bunker. Zipper bunker seal prevents dusting.

SINCE 1901 S-A STEPHENS ADAMSON MFG. CO.

STEPHENS-ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS
LOS ANGELES, CALIFORNIA
BELLEVILLE, ONTARIO



This Size #14 Fast's Coupling connects a turbine and a generator at the Gould Street Station of the Baltimore Gas & Electric Co.

This Fast's Coupling runs smooth after 29 years of service!

This Size #14 Fast's Coupling has never had a major part replaced since its installation on January 4, 1927.

The Baltimore Gas & Electric Company has provided excellent care and inspection . . . examining the coupling during each routine overhaul of the turbine and generator. The last inspection (shown above) was during the fall of 1955.

Unique design permits Fast's Couplings to compensate for both offset and angular misalignment of shafts and eliminates the wear of metal upon metal. It provides positive lubrication which forms a film on load-carrying surfaces of the teeth. Metal bearing rings located at the mid-axis of the teeth keep out dirt, grit and moisture—keep lubricant in. Fast's metal-to-metal seal protects the lubricant against pollution.

A Koppers engineer can show you how Fast's Couplings will give you extra years of service and reduce down-time. For more details, write to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 3303 Scott Street, Baltimore 3, Maryland.

Koppers Company, Inc.
Metal Products Division
Baltimore 3, Maryland

Engineered **Products**
Sold With ***Service***

KOPPERS

THE ORIGINAL
FAST'S Couplings

LOUIS N ROWLEY, EDITOR • MARCH 1957 • ESTABLISHED 1882 **Power**

Does economy always pay?

At lunch the other day, a boiler-insurance specialist told about a company that had wasted more than $200,000 in maintenance because they failed to invest a trifling fraction of that amount in water-treating equipment to protect a new steam-generating unit.

I'm not citing this to stress the need for proper water conditioning, although that's one of the morals to be drawn from the incident. What I'm concerned about right now is the high cost of short-sighted equipment buying, the kind of skimping that proved so expensive in the long run for the company in our friend's example.

I'm concerned about "penny-wise" planning and "price" buying because I see and hear so much of it these days. This is probably only natural.

For most businesses, competition is tougher than ever. We're all cost conscious, and rightly so. Thus, in equipment buying, we try to whittle down the cost that's in full view—the first cost. And we lose sight of the fact that the cost of operating and maintaining the unit over its lifetime may be far greater than the initial investment. It's like the old gag about marriage: "It isn't the first cost that hurts, it's the upkeep."

When we buy a piece of equipment, we commit ourselves just as irrevocably to the future costs of upkeep as we do to the purchase price. We might compare the first cost to the visible part of an iceberg, and the future costs to the submerged part, hidden but enormously important. The test of smart purchasing lies in achieving the lowest *total* cost—initial investment plus operating and maintenance costs over useful life.

Now there's nothing new in this—lowest total cost has always been the goal. But the upkeep part of this equation—the future costs—has greater importance today than ever before. Why? One big reason: The major item in operating and maintenance costs is manpower, and that's just about the most expensive thing we buy today. And it's going to be even more expensive tomorrow.

There's another element of future costs that looms large today—downtime. As production rates increase, and manufacturing operations become more complex, loss of even small periods of production time becomes surprisingly expensive.

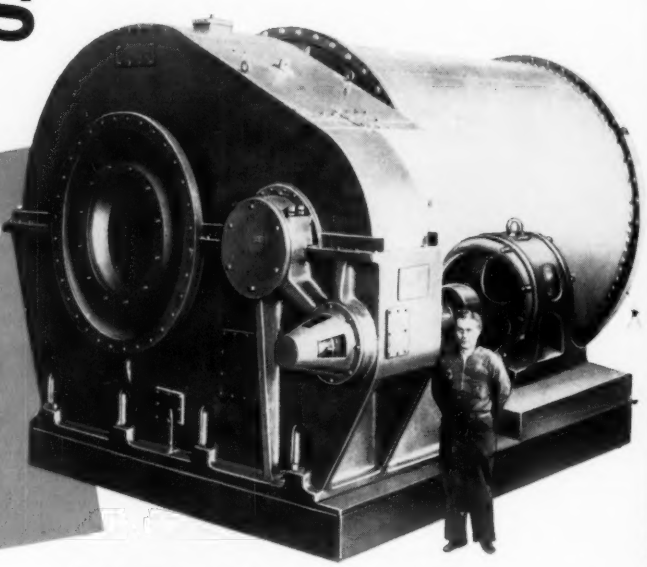
Thus, when we buy equipment, we can't afford to lose sight of any possibilities of reducing future operating and maintenance costs. To a greater extent than ever before, it will pay to spend more at the beginning for design features that will cut operating-labor needs and reduce maintenance to a minimum. And it will pay to spend more to get equipment using modern corrosion-resistant and wear-resistant materials.

Sure, we'll still want to see that we get the most equipment for our money, that the first cost is appropriate for the quality. But let's not buy on price alone, without regard for the future. Now, more than ever, the best is apt to prove the cheapest in the long run—and that's where it counts!

Kennedy Pulverizers Pay for Themselves many times over!

- ★ In utilizing low priced coals
- ★ In low cost maintenance
- ★ In producing superfine coal for fast combustion
- ★ In availability . . . over 99%
- ★ In increased efficiency
- ★ In maintaining a clean furnace
- ★ In reducing losses through the smoke stack

KENNEDY PULVERIZED COAL FIRING SYSTEM SAVES $3.00 OR MORE PER TON ON COAL!



AIR SWEPT TUBE MILL. Slow-speed ball mill for perfect pulverization by air separation. Low-cost grinding of all grades of coal regardless of hardness. Grinding balls can be added without shutting down. Continuous year-to-year operation with better than 99% availability. Complete designs for steam and coal installations.

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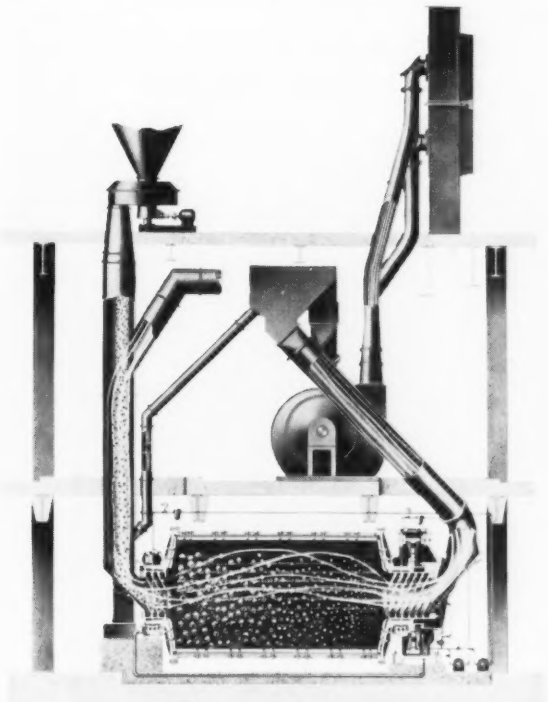
Don't accept a "second best" system with high maintenance costs. Insist on a KVS Pulverized Coal Firing System for your boiler – either present or future – and gain the advantages of over-all lower maintenance costs.

GET THE FACTS – *THEN* MAKE YOUR CHOICE.



COAL FIRING SYSTEM. Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.

NO OTHER SYSTEM INCLUDES ALL OF THESE FEATURES . . .

UNBURNT CARBON LOSSES LESS THAN ½%.

FULLY AIR SWEPT

•

COAL PULVERIZED TO SUPERFINENESS

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COAL COMPLETELY CARBURETED
Ready for Combustion

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BIG TRUNNIONS FOR AIR SWEEPING

•

BALLS ADDED WITHOUT SHUTTING DOWN

•

LOW OPERATING AND MAINTENANCE COSTS

•

85% TO 90% THROUGH 200 MESH

•

20% MOISTURE REMOVED WHILE PULVERIZING

•

PULVERIZES ANY COAL—BITUMINOUS, ANTHRACITE, FLUID COKE

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TRAMP IRON ACTUALLY AIDS IN PULVERIZING

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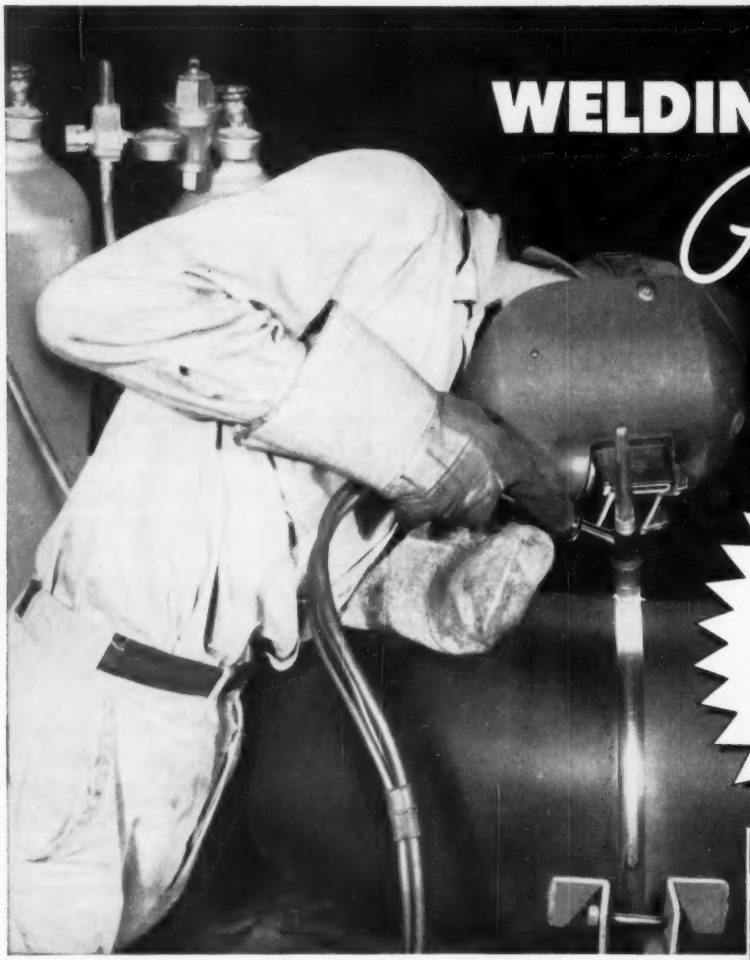
WELDING at Pittsburgh Piping



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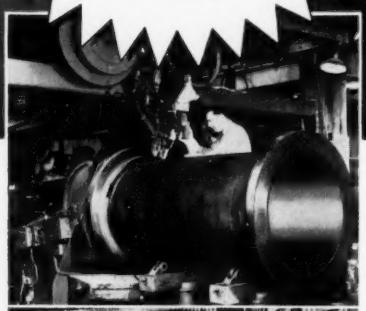
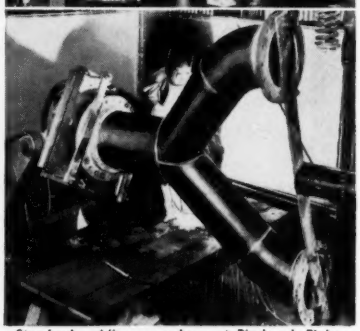
Modern power and process piping fabrication requires the highest degree of welding skill, as well as technical supervision which provides complete control of welding procedures. All Pittsburgh Piping welders and welding operators are performance qualified in accordance with Standard A.S.M.E. Welders' Qualification Test. They are specially trained in the exacting requirements of fabricating piping and related equipment for high-temperature, high-pressure central station service, corrosion-resistant applications, and nuclear power installations.

Fabricated high pressure boiler feed piping shop fabricated at Pittsburgh Piping. Comprises bends and forged laterals.





Standard welding procedures at Pittsburgh Piping are: Inert gas tungsten arc (above); automatic submerged arc (center); and manual metallic arc (bottom).

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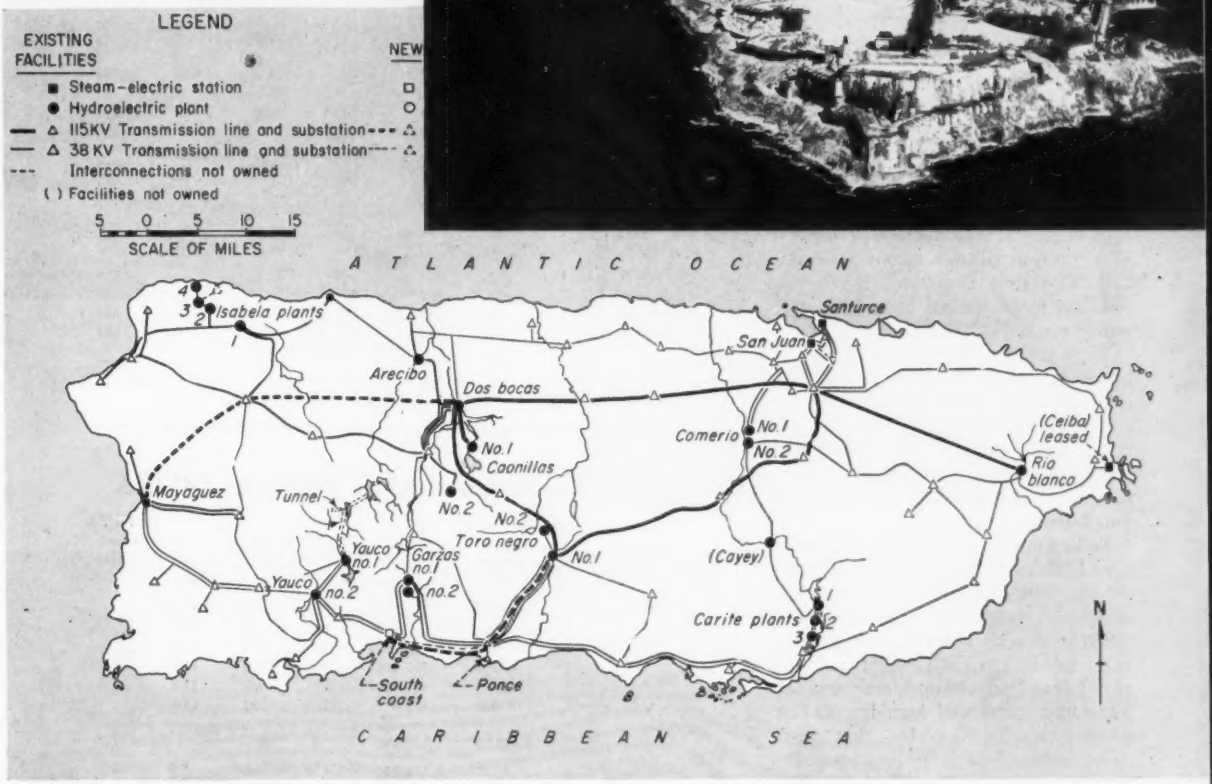
ENGINEERING and MANAGEMENT SECTION MARCH 1957

B G A SKROTZKI
Associate Editor in Charge



San Juan, capital city, headquarters for planners of Puerto Rico's future development who must depend on . . .

POWER—Keystone in a changing economy

► WHAT HAPPENS to a population that threatens to outgrow its limited natural resources? This grim situation was eased by discovering that people, themselves, could be a rich natural resource! Puerto Rico puts this idea to work by encouraging creation of new industry and commerce on its compact, lovely tropical island. But tax-free inducements and vocational training of workers in its "Operation Bootstrap" must be backed up by a supply of reliable power. This is the story of how Puerto Rico supports the power end of the program and what it faces for the future. With careful supervision, planning and execution the Commonwealth should soon live up to its entrancing name "Port Rich." TURN PAGE ►

By B G A SKROTZKI, *Associate Editor*

Tremendous financial needs generated by a multiplying population threatened to compound a chronic economic unbalance in the Commonwealth of Puerto Rico. This ominous possibility put the ingenuity of the Commonwealth planners to the test. Realizing that we live in an industrial world, and that industry needs people as workers, and as a market, the PR planners had the vision and courage to embark on an ambitious program of industrializing their scenic tropical island.

This program, dubbed "Operation Bootstrap," has not been an overnight panacea and is not the sole solution to PR's problem; but it is now rolling along in high gear. Along with people, modern industry needs power with a high degree of reliability. Growing out of a rural tropical economy we knew that "Operation Boostrap" to prove itself had to be backed by an adequate power system.

We were curious about how PR is handling the power part of the program. This island "test tube" of over 2.2 million people has to be self sufficient powerwise. While PR has the people in overbundance—would it have the power to give the program a solid foundation?

To find the answer, I boarded a southbound plane in 24-F New York City —with "sympathetic" murmurs of my associates about the rigors of wintertime travel in the tropics ringing in my ears. Landing at PR International Airport I found an ultra-modern terminal. The temperature and humidity at first meeting was stifling—but that gradually wore off with acclimation. The airport, even at 11 pm, was roaring with people. It literally is the "crossroads" of this part of the world, with Miami 1000 miles away, Mexico City 2100 miles, Caracas, Venezuela 570 miles, Panama City 1200 miles, New York City 1600 miles, Lisbon 3600 miles, and Dakar, Africa about 3200 miles. Air service can be found to any part of the world. The airport, open over a year, was designed for traffic conditions expected in 1962—but it's already overcrowded.

On later trips, over and around the island, it proved to be a scenery-lover's delight. The strong pull of "home" that Puerto Rico exerts on all its emigrant people was easy to understand. Nostalgia for this beautiful tropical island could easily forget heat, humidity and low living standards. Mountains reaching up as high as 4400 ft dominate the views inland. Not apparent to the eye is the Puerto Rico Deep, almost 29,000 ft, a few miles north of the island in the restless Atlantic Ocean.

Taxiing from the airport to the Caribe Hilton Hotel in San Juan, six miles away, the cabbie "drove" his horn with as much speedy abandon as he piloted his cab. Between wild spurts and sharp braking, I spotted some new light-industry plants, a supersize modern multiple-housing project and several real-estate developments. Some modern shopping areas strongly resembled those back home.

Slightly shaken, I crawled out of the cab at my destination to stand before a 10-story ultra-functional building that seemed to be all picture windows. It was obviously designed to impress the luxury tourist trade. This unit for liv-

Table 1—Hydro plants of PRWRA

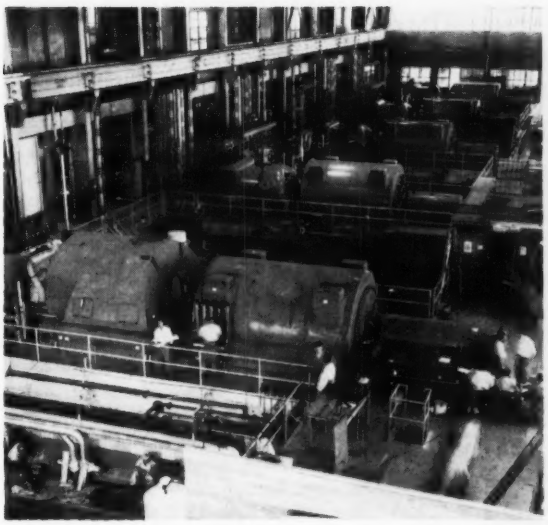
Plants	Units	Nameplate rating, kw	Average head, ft	Drainage area, sq mi	Useful storage, mwhr	1955-1956 annual generation, mwhr
Toro Negro No. 1	4	8,640	1,610	11.5	3,760	39,153
Toro Negro No. 2	1	1,920	630	1.6	1,810	3,137
Carite No. 1	4	3,360	742	7.9	10,000	7,777
Carite No. 2	1	640	335			3,318
Carite No. 3	1	640	217			1,697
Garzas No. 1	2	7,200	1,210	6.3	6,750	19,013
Garzas No. 2	1	5,040	798			14,807
Caonillas No. 1	2	17,600	482	50.0	22,600	24,374
Caonillas No. 2	1	4,000	170	30.7	—	7,703
Dos Bocas	3	18,000	145	170.0	2,640	29,592
Arecibo	2	720	166	—	—	4,321
Comerio No. 1	3	1,600	169	133.0	150	11,618
Comerio No. 2	2	3,200	140			11,364
Rio Blanco	2	5,000	1,320	6.0	8	26,008
Yauco No. 1	1	20,000	740	39.6	11,470	11,458
Yauco No. 2	2	8,000	310	56.9	3,550	8,575
Isabela No. 1	2	704	106	25.0	6,800	4,400
Isabela No. 2	2	800	104			3,367
Isabela No. 3	1	1,040	132			3,484
Isabela No. 4	1	1,300	150			531
Totals	38	109,404				235,697

Table 2—Steam-electric plants of PRWRA

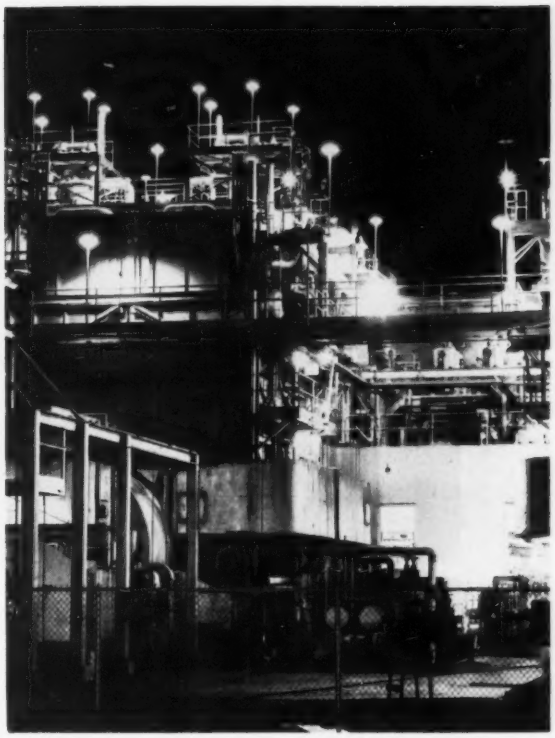
Plant	Unit	Rated capacity, kw	Boiler capacity, lb per hr	Throttle conditions Pressure, psig	Throttle conditions Temp, F	Kwhr per gal of oil	1955-1956 annual generation, mwhr
San Juan	1	20,000	200,000	900	850	12.0	—
	2	20,000	200,000	900	850	12.0	—
	3	20,000	200,000	900	850	12.0	—
	4	20,000	200,000	900	850	12.0	—
	5	40,000	425,000	1250	950	13.0	—
	6	40,000	425,000	1250	950	13.0	—
		160,000	1,650,000				624,873*
Santurce	1	7,500	110,000	450	710	8.0	—
	2	7,500	110,000	450	710	8.0	—
	4	5,000	65,000	450	710	6.0	—
	5	5,000	70,000	450	710	6.0	—
		25,000	355,000				91,091
Mayaguez	1	2,000	30,000	350	650	4.0	—
	2	2,000	30,000	350	650	4.0	—
	3	5,000	50,000	610	750	8.0	—
		9,000	110,000				51,372
Ceiba	2 units—leased from U.S. Navy—8,000 kw total capacity						7,417
Totals	16	202,000	—	—	—	—	774,753**

*—Unit 6 under construction

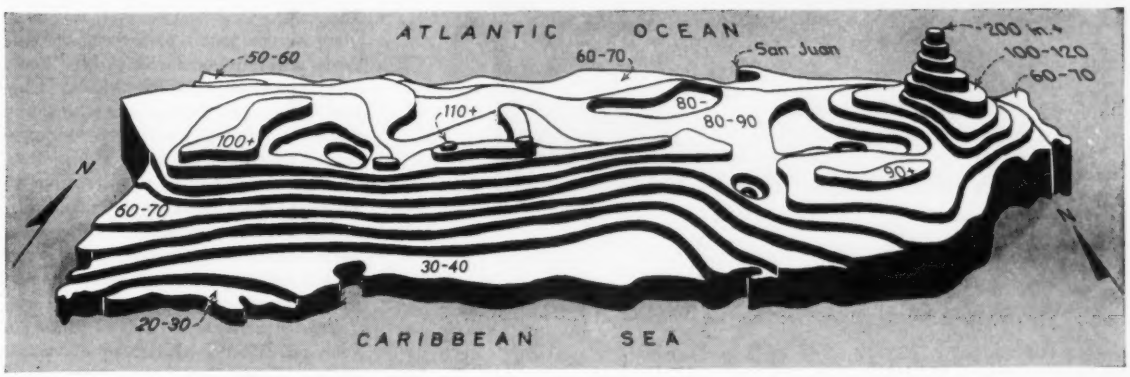
**—Floating power plant, no longer used, generated 107,646 mwhr additional



1 Turbine room of San Juan steam station, backbone of Puerto Rico's government-owned system, now has six units



2 One of San Juan station's semi-outdoor boilers; uses forced- and induced-draft fans, regenerative type air heater



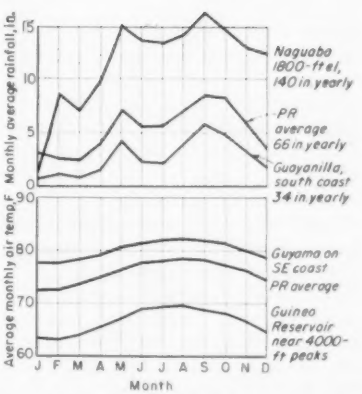
3 Average annual rainfall map of Puerto Rico shows the effect of mountains forcing clouds to drop most of their moisture on northern side (inches yearly)

ing-as-you'd-like-to-be-accustomed-to proved to be part of Bootstrap. Tourism is being encouraged as much as industrialization—about 800 hotel rooms will be added this year, doubling San Juan's capacity. About 160,000 people visited PR during 1956. All rooms, two restaurants and the casino in the Caribe Hilton are air conditioned.

WHAT I FOUND

This short introduction to PR literally shouted its demand for power capacity—newness of these industrial, commercial and residential projects suggested a phenomenal rate of load growth.

To get the PR power story I called on Dr M Quinones, chief engineer of the Puerto Rico Water Resources Authority (PRWRA). His invitation had originally prompted my visit to PR. Through him I met S L Descartes, executive director of PRWRA, R R Ramirez, head of the Power Division, and J A Mendez, a former fellow worker of mine, who is now superintendent of steam plants and mechanical planning engineer. All these men and their associates, with perfect hospitality,



4 Monthly average rainfalls and temperatures point up subtropical climate

5 Two oil refineries in Puerto Rico receive crude petroleum from Venezuela for processing and consumption on island

6 This mica splitting plant is typical of light industry sponsored by the tax-exempt "Operation Bootstrap" program

"filled me in" on the PR power facts.

PRWRA now supplies all the power for PR with insignificant exceptions. The Authority grew out of the original Puerto Rico Irrigation Service formed by law in 1908 to provide an irrigation system for the South Coast plains. The island forms a rough rectangle, about 100 miles east to west and 35 miles wide north to south, with an area of 3423 sq miles.

The mountains range themselves east to west somewhat south of the island center line. They slope up from the north coast plain and drop sharply to the south coast plain. Clouds drifting in on the trade winds from the east and north drop most of their rain on the northern side of the mountains, Fig. 3. El Yunque, 3500-ft high, gets an average of more than 200 in. rain per year. Here, it rains sometime during every day throughout the year. This supports a "rain forest" featuring palm trees and huge fern trees.

Puerto Rico's rainy season extends from May through November, Fig. 4. Air temperatures fluctuate through a narrow range, lower values prevailing at higher elevations. In San Juan on the north coast they swing from about 72 F at night to 85 F during the day. Average relative humidities vary from 87% at night to 74% during the day. South coast humidities average about 6% lower.

Hydro development. Elevation and topography combined with high annual rainfall made hydro stations the preferred choice for development as power sources. PRWRA now has 20 hydro plants with a nameplate capacity of about 110 mw. Yauco No. 1 with a single 20-mw unit is the largest, Table 1. The Authority believes it has reached the end of its economic hydro developments. Any future additions will only be as byproducts of reservoirs developed primarily for water supply, and irrigation.

The two Yauco plants are part of a multiple-purpose development that supplies irrigation to about 26,000 acres of farm land and 6.5 mgd of domestic water to towns of southwestern PR. It also provides flood protection and develops power. Of the 65.3 sq mi drainage area, 39.6 lie on the rainy north side, but all waters discharge to the south coast. A total of 64,400 ft of tunnels 8- to 11-ft diameter are used in the diversion project.

Four hydro plants are run-of-river, the others have limited storage capacity, Table 1. Nine of the plants are fully automatic. They are supervised by remote control from other hydro plants.

Though hydro was the backbone of the PRWRA system up to and through World War II, it now takes a back seat to steam. Four steam plants, Table 2, provide 162 mw installed capacity with a somewhat higher capability. San Juan, Fig. 1, 2 and 9, is the modern plant on the system at present and features a totally enclosed turbine room and semi-outdoor boilers. Unit design has been used. but steam mains and feedwater piping have been interconnected to reduce outages.

PRWRA buys excess power from 15 of the 32 sugar mills on the island during their 8-month grinding season. They burn bagasse, the residue from sugar cane grinding, and use bunker C oil as a supplementary fuel.

During fiscal year July 1, 1955 to June 30, 1956 PRWRA produced its generation as follows:

Hydro stations	235,697	mwhr
Steam stations	774,753	
Floating plant	107,646	
Purchased	17,896	
Total	1,135,992	mwhr

Transmission system. Generating stations tie to the load through a transmission system having 128 circuit-miles of 115-kv lines and 947 circuit-miles of 38-kv lines, p 75. These include 13.6 miles of 38-kv underground gas-filled cable from San Juan station to Bayamon substation. Forty-four transmission substations and 110 distribution substations handle the load of the consumers. A 4.16-kv overhead primary network serves the San Juan metropolitan area; all other distribution is radial.

In some areas the transmission sys-

tem needs heavy overinsulation because of dust and salt deposit on insulators or heavy rains.

System performance. During 1955-1956, system capacity reached:

Hydro stations	109.4 mw
Steam stations	162.0
Floating plant	30.0
Total	301.4 mw

This compared to a peak load of 209.7 mw. These comfortable looking figures don't reveal the critical situation that arose during the year.

A severe drought started in 1955, carried through the year so only 65% of normal water storage was available at the beginning of the fiscal year. On top of this, peak load climbed by 18% above the previous year in an unexpected spurt. New capacity wasn't due in service (San Juan No. 5 and Yauco No. 1) until after the peak.

Frequency and voltage reduction helped shave the peak in the early part of the year; and sugar mills helped out by generating to their full limits. This situation was relieved by leasing the floating power plant YFP-10 from the U.S. Navy. It was towed to San Juan from Jacksonville, Fla. and hooked into the PRWRA system on July 28, 1955. All shutdowns for maintenance were postponed and the system ran without spinning or cold reserve until the new units went in service.

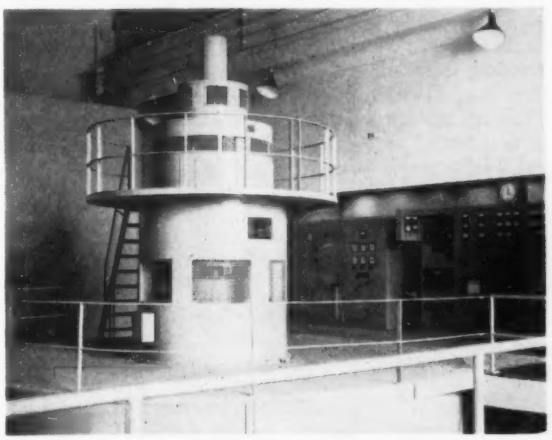
By the time San Juan No. 5 and Yauco No. 1 went in service, new heavy loads, such as Commonwealth Refinery, were being served. To do urgent maintenance on the steam units of the system, YFP-10 was kept in service until April 3, 1956. It was towed back to Jacksonville on May 16, 1956.

System annual load factor ran at 61.8%. Hydro plant factor was only 28.8%, and steam plant factor 64.7% which gave a system plant factor of 53.0%. Steam-plant heat rate averaged 13,750 Btu per kwhr. With a fuel oil (bunker C) cost of 36.5c per million Btu this gives a fuel cost of 5.02 mills per kwhr. Since oil must be hauled over 500 miles from Venezuela, this compares favorably with U.S. experience. PR has no fuel resources of its own, it must all be imported.

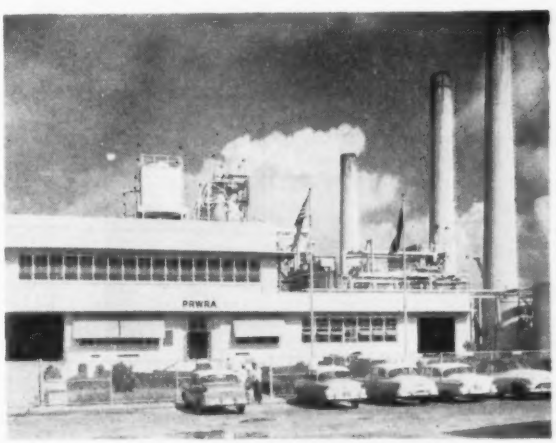
Of the 2781 employees of the PRWRA, 67% are in the Power Division. This operation has all the earmarks of a well-engineered well-run utility.

Fig. 10 shows a typical winter day load curve for the system. It features a "cooking" peak at noon and another cooking and lighting peak at 7 pm. It

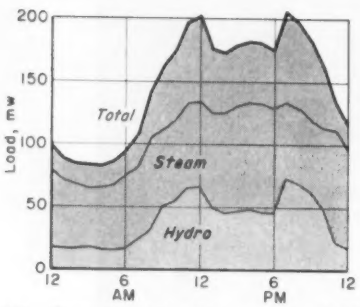
7 Dos Bocas Dam, 188 ft high, 1317 ft long, concrete gravity type impounds water for 3-unit 18,000-kw hydro station



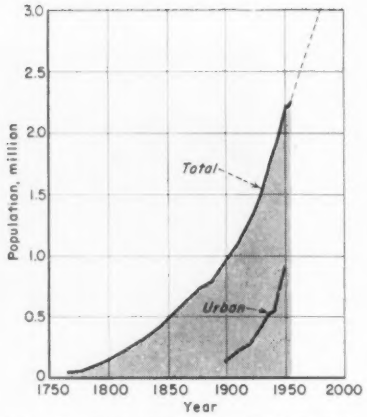
8 Yauco No. 1, 20-mw, largest hydro unit on system, installed recently, is part of water diversion crossing divide



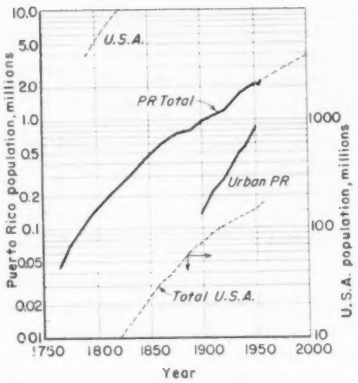
9 San Juan steam station has totally enclosed turbine room, *left*, and semi-outdoor boilers, *right*, 160-mw plus rating



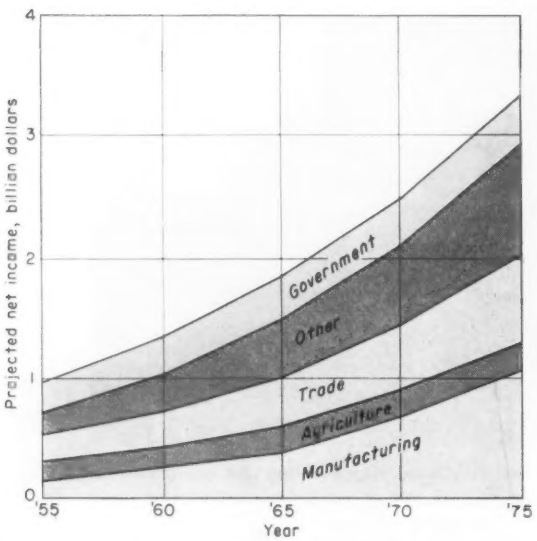
10 Typical winter-day system load curve features two peaks every day



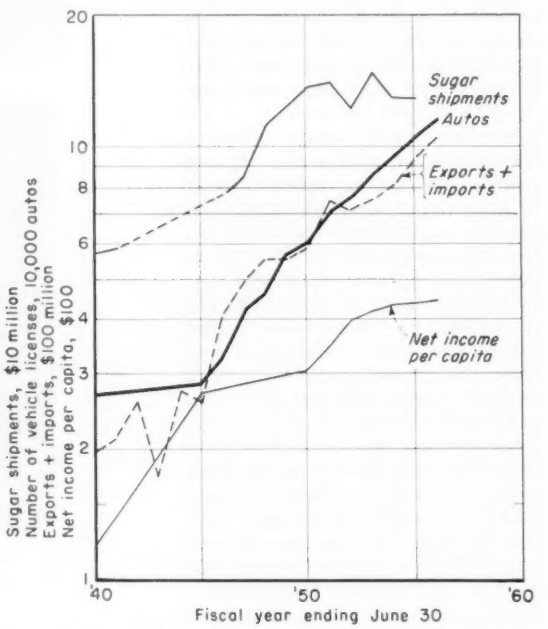
11 Zooming population growth must be teamed with more employment needs



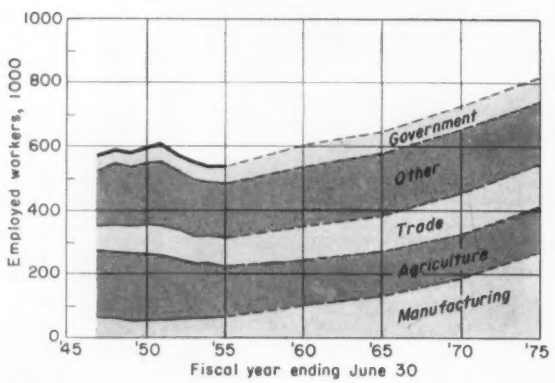
12 Industrialization makes urban population growth rate top total rate



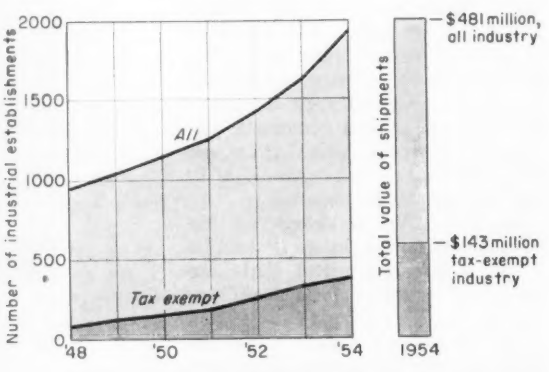
14 Forecast of net income by economic segments shows why PR vigorously pushes its "Operation Bootstrap" program



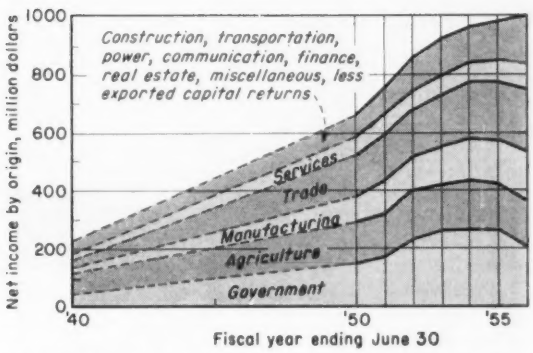
15 Sugar shipments, auto registrations, exports, imports, net income per capita show PR's progress since year 1940



16 Forecast of employment needs in Puerto Rico shows that large part of growth is in industry needing trained men



17 Sheer rise in population needs accounts for part of rise in number of industrial plants, Bootstrap also helped



13 Net income of Puerto Rico was once dominated by agricultural activities, but other areas now make more money

Shed houses generator on trailer

South Coast Unit-1 generator stands on dock at Ponce, housed in this shed. This protects generator windings from hard showers and high humidity. Electric strip heaters at strategic spots on windings prevent condensation and keep the windings dry.

doesn't get dark until after 6 pm during January in this tropical isle. Ratio of early morning to peak loads runs about 1 to 2.5. Relative dominance of domestic load tends to flatten the load curve. Many urban home owners run their air conditioners primarily at night to reduce the high ambient humidity. Strong trade winds blowing during daylight hours make the humidity tolerable; many home owners don't run their air conditioners then.

Energy sales during 1955-1956 were:

Residential	335,600 mwhr	36.0%
Commercial	226,800	24.4
Industrial	300,600	32.3
Other	67,800	7.3
Total	930,800	100.0

Dearth of heavy industry gives residential and commercial consumption a much bigger portion of total energy consumption than in continental U.S.A. PRWRA planners expect that light industrialization now going on may even give residential consumption a larger part in the future with a concurrent growth in commercial activity that largely serves residential needs.

How did PRWRA get this way? Just erecting an energy generating and transmission system in an undeveloped land will not insure its economic growth. It's the other way around—developing an area industrially and commercially calls for concurrent erection of an adequate electric utility system. Electric energy, after all, is a tool to do a job more quickly and cheaply. So, to get an idea of the factors that demanded the development of PR's power system let's look at its economic history and future potential.

Fig. 11 shows the total and urban growth of population in PR since 1765. It tells a story of steady expansion with high fertility. Only during the last six years does the curve begin to wobble. Longer and more thorough education, older marrying ages, higher per capita income and increasing net emigration to continental U.S.A. are offered as reasons for the tapering growth rate.

Fig. 12 shows that on the rate of growth basis PR's urban population is rapidly overtaking the rural total by a marked amount. These relative trends point up the gradual commercialization of the island which has been going on in advance of Bootstrap. The trend also shows the deemphasizing of agriculture as the island's economic mainstay.

Comparing the total U.S.A. and PR population curves we see that their growth rates are surprisingly parallel. PR's growth primarily depended on native fertility while in the U.S.A. growth was accelerated to a large degree by immigration.

Economic activity. Fig. 13 shows the net income of the various activities of PR from 1940 to 1955. Total net income reached a hair over $1 billion in 1956. In 1940 agriculture was the largest producer of net income, but today it is exceeded by government and trade and almost equalled by manufacturing.

Our next question was where is PR heading? Dr Alvin M Mayne, director of Bureau of Economics and Statistics, gave us a rundown on that. He was in the middle of making revisions of his economic forecasts, but Fig. 14 shows his estimates prior to the present study now under way. He expects manufacturing to be the dominant income producer by 1975.

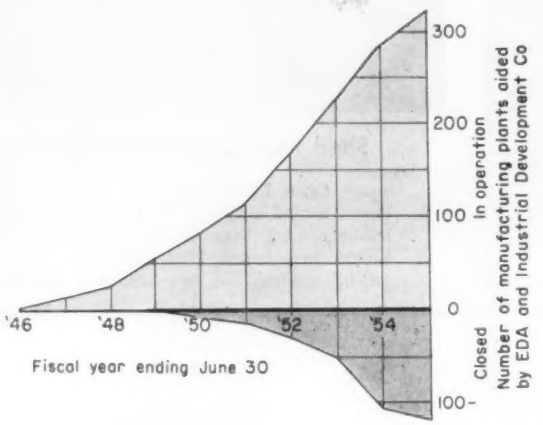
While the other major segments of the economy will grow markedly, agriculture's slight expansion will make it the smallest. Dominant product for export is sugar, but PR also raises tobacco, bananas, pineapples, citrus fruits and some coffee. Few vegetables are produced on the island; most vegetables and meat are imported frozen from U.S.A. for consumption by urban PR. Staple foods of rural PR are rice and beans.

Fig. 16 translates these economic incomes into number of people employed. Here again manufacturing shows the greatest growth of all segments, while agriculture may shrink slightly. About 15% of the labor force was unemployed in 1954-1955.

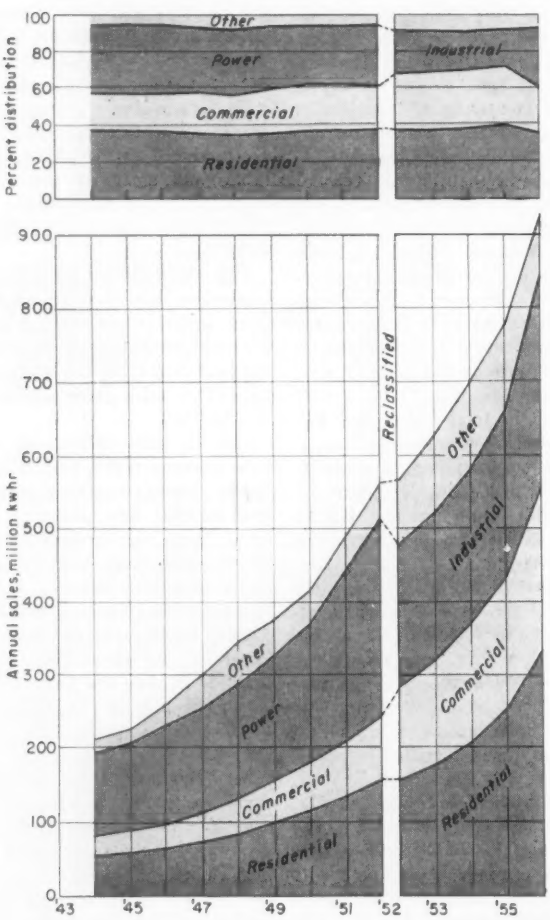
Fig. 15 gives indexes of other factors showing PR's economic growth. Sugar shipments, climbing to a high level in 1950, have stayed on a plateau since. Auto registrations have made a steady climb since 1945. High annual registration fees, initiated a short time ago, favor importation of low-cost autos. Annual registration fee for a Ford or Chevrolet runs about $60, for a Buick, about $360. I'm told Cadillacs are fast disappearing from the island; fees are based on selling price of the cars at the factory.

From a low in 1943, the export and import activity on PR has steadily risen at an encouraging rate. Net income per capita was hiked strongly during the war, but its rate of growth has tapered off in the last few years. To bend it upwards "Operation Bootstrap" was initiated in 1946. Fig. 17 gives some idea of recent growth in

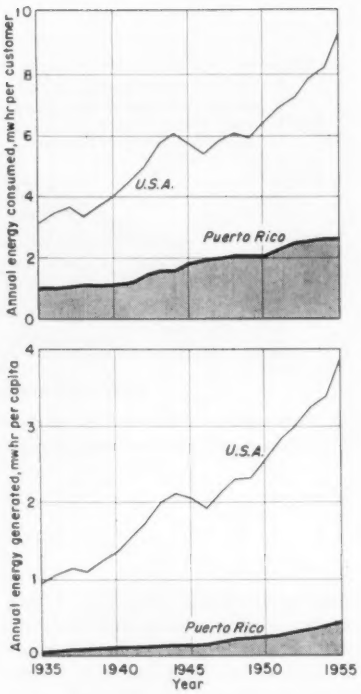
Vigorous annual growth rate of PR's electric system points up its relative newness



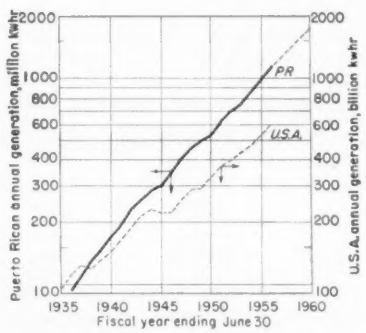
18 Economic Development Administration and PR Industrial Development Co teamed to produce these hits and misses



23 All segments of PR's activity make growing demands on electric energy supply; residential takes largest portion



19 Per customer and per capita use of electric energy shows PR's status

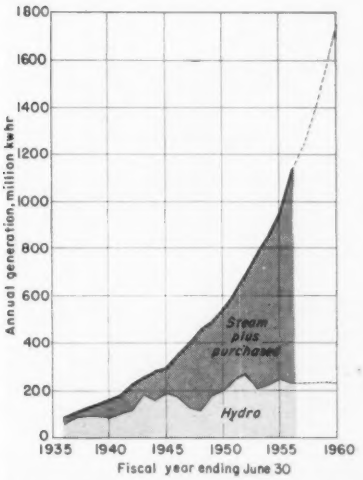


21 Relatively undeveloped PR has higher kwhr growth rate than U.S.

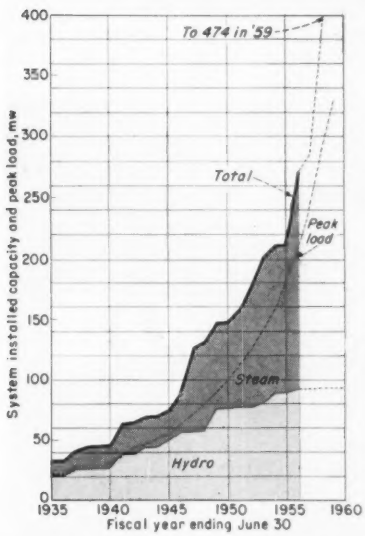
industrial activity and the contribution made by Boostrap in encouraging tax-exempt industry growth. The latter made almost 30% of the total industrial shipments in dollar terms.

Fig. 18 shows the number of plants running each year that were established under the Bootstrap program. The lower curve shows that this operation is not a sure cure and that failures have grown with passing time too. But the net gain in successful plants proves the basic soundness of the program.

Power consumption. How does all this react on PR's electric power system? Fig. 23 shows the annual sales



20 Annual generation shows diminishing share produced by PR's hydro



22 Rated capacity of PR's generating plants keeps up with growing peak

tials for growth are the present drive for industrialization and wider air conditioning—commercial, industrial and domestic.

On a per capita basis PR doesn't look so good. This reflects the basically low per capita income and chronic unemployment which denies the average Puerto Rican the advantages and conveniences of electric domestic appliances.

Generation. How have these individual demands added up on the system? Fig. 21 shows PR annual generation since 1935. Since 1945 generation has doubled in a little less than every six years. Fiscal 1956 was 18% higher than 1955, equal to doubling every 4.2 years. This rate of growth outstrips that of U.S.A. also shown in Fig. 21; average time for U.S.A. doubling runs about 8.5 years. Using electric generation growth as an index, this seems to show that PR is catching up fast to a higher standard of living. We have projected our estimate of the trend to 1960; an expected output of 1.74 million mwhr.

Fig. 20 shows how this generation was produced since 1936. Practically all future growth in generation will have to be produced in thermal plants. Geometric growth of expected demand spells out an active program of new plant expansion in the future.

Fig. 22 shows the capacity of PR electric systems since 1935 compared with the annual peak load. The comfortable margin of reserve shown in the chart can easily disappear with a dry year as we've already related. Dotted lines show the projected additions in capacity, all thermal.

Plant expansion. Station location for future new capacity will be primarily determined by the area of demand. This minimizes the expansion of the transmission system.

San Juan No. 6 is scheduled for operation in February 1957. The 40-mw preferred-standard turbine-generator is estimated to cost $182 per kw rated capability. Anticipated actual capability of 50 mw lowers cost to $160 per kw. Thermal efficiency of steam turbines takes a beating from the high cooling-water temperatures which run in the neighborhood of 80 F.

Enough room exists at San Juan to install additional units as load growth in the metropolitan area warrants.

South Coast No. 1 scheduled for operation in December 1957 will also be a 40-mw preferred-standard unit. Estimated cost will be $234 per kw rated capability and $206 per kw anticipated capability. South Coast steam plant, Fig. 24, will be on the Caribbean shore, west of Ponce, near Penuelas. The plant stands near the Commonwealth Oil Refinery which will supply tar at 700 F as fuel. Cost is estimated at 31c per million Btu. The plant will use the same arrangement as San Juan, enclosed turbine and semi-outdoor boiler.

Early delivery of the generator, upper right, p 81, was prompted by the delay experienced with San Juan No. 6. The steel strike, the long Westinghouse strike and a six-week longshoremen's strike in PR combined to delay starting by about three months. Urgent need for new capacity made early delivery prudent. Road and bridges are currently being strengthened for transporting the unit while the plant foundations are being erected at the site.

South Coast No. 2 scheduled to start in December 1958 will duplicate No. 1. Estimated cost runs $152 per kw rated capability and $134 per kw anticipated capability. Fast growth of heavier industries in this area prompts placing this capacity on the south coast of PR.

Mayaguez No. 1 will be a 20-mw gas turbine scheduled to start in December 1958. This will be placed in a new building not far from the present 3-

of PRWRA in the three primary classes since 1944. Reclassification of rates in 1952 obscures the trends, but while all classes of service are growing, residential consumption forms the largest percentage.

Since U.S.A. is one of the largest per capita users of electric energy let's see how PR's use compares. Fig. 19 shows this on two bases (1) mwhr consumed per customer and (2) mwhr generated per capita. Making allowances for little heavy industry and more daylight hours throughout the year, PR does not appear too far behind on a per customer basis. Two largest poten-

Electric appliances worth more than workers' homes

First outward signs of Puerto Rican rural workers emergence from poverty is the TV antenna. Rural electrification programs bring conveniences of electric service to poorer families of PR.

Refrigerators often stand in living rooms with radio and TV as objects of pride. Homes rarely use window glass.

These houses typify those of villages and slum sections of cities. They are disappearing with erection of vast low-cost real estate developments and government multiple-housing projects.

unit 9-mw Mayaguez steam plant. Estimated cost will be $150 per kw.

This Brown Boveri unit will act as a transmission line booster, peak-load unit, and end-of-line emergency reserve. This plan proved more economic than completing a 115-kv transmission loop to this area of PR, despite the poorer fuel economy of gas turbines.

Fig. 25 shows two gas-turbine units installed in Livorno, Italy. The Mayaguez units will be the same design. The Livorno units are rated at 25 mw, similar units in Canada with 30-F ambient develop 30 mw. The Mayaguez unit will develop 20 mw with 85-F air inlet temperature.

The 2-shaft gas-turbine unit has a h-p and l-p combustor. H-p turbine drives the h-p compressor. L-p turbine drives the l-p compressor at 3000 rpm and through a step-up gear drives the 60-cycle generator and exciter at 3600 rpm. Basic turbine design was predicated on driving 50-cycle generators. A clutch between gear and generator allows disconnecting generator from the turbine and compressor to serve as a synchronous condenser. Starting motors and clutches mount on each turbine shaft.

Air enters the 14-stage l-p compressor to be raised through a pressure ratio of 3.9. After passing through an intercooler the partly pressurized air enters the 17-stage h-p compressor for a further pressure ratio increase of 4.5. H-p air enters the h-p combustor for heating to 1200 F. After expanding through the 6-stage h-p turbine the hot gas enters the l-p combustor for reheating to 1200 F. Reheated gas flows through the 5-stage l-p turbine and exhausts to atmosphere. The expected limited use of this unit does not justify a regenerator to recover exhaust heat.

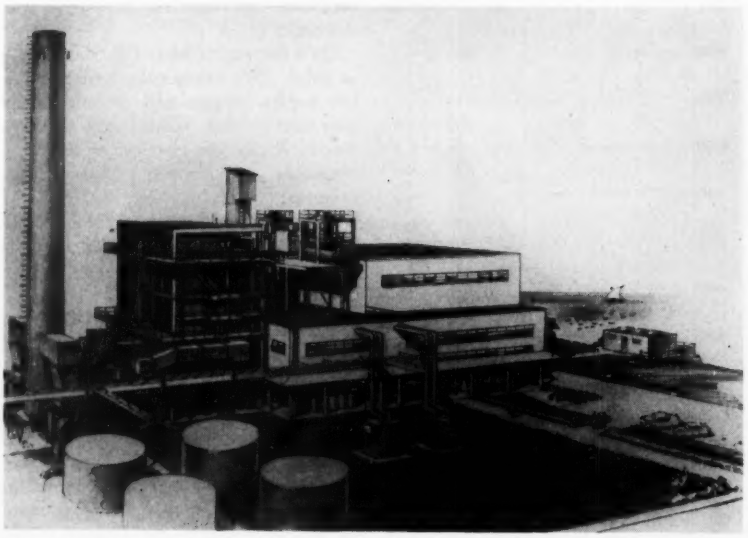
These units can be started from cold and be fully loaded in eight minutes. Motors and turning gears on each shaft assure even contraction of rotors during cooling after unloading.

Mayaguez No. 2 will also be a 20-mw gas-turbine unit, a duplicate of No. 1 in design and cost; scheduled to start in December 1959. The two-unit plant will resemble Fig. 25.

Future units. A site across the bay from San Juan, in Palo Seco, is being studied as a possibility for a new station in the metropolitan area. Studies for the first unit here indicate that a steam turbine of 75-mw capacity with a reheat cycle at 1450-psig and 1050/1000-F will probably serve the system with best economy and not upset reserve needs.

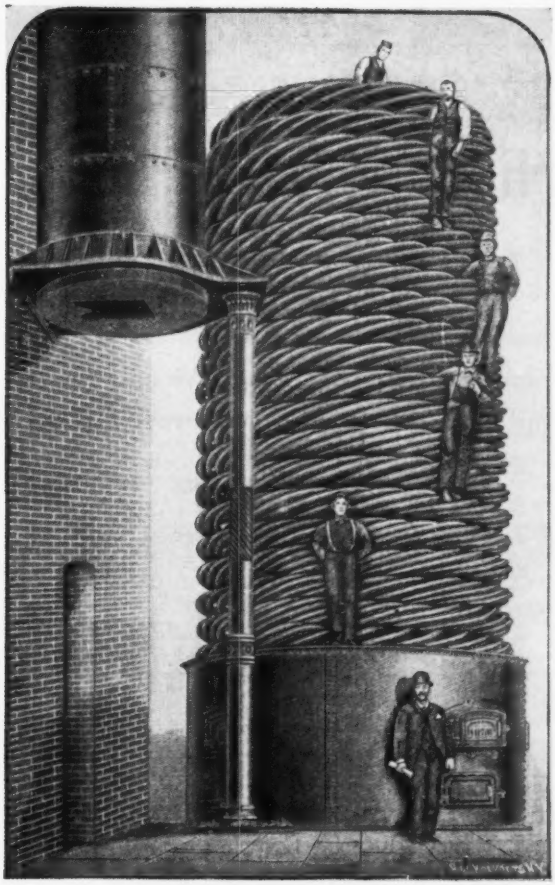
PRWRA is not overlooking any bets. It watches nuclear power developments closely but feels that it cannot afford atomic energy without a subsidy that would reduce its net cost to what can be realized with a modern high-pressure steam plant. The AEC, however, plans to install a nuclear research reactor in the University of Puerto Rico. This will help demonstrate to South America the potentialities of nucleonics in industrial applications. PRWRA has engineers studying nuclear technology at the Argonne National Laboratory in Lemont, Ill.

Another area of long range interest is solar energy. A project recently established, investigates the potential of this energy source for PR. Stanford Research Institute is working with EDA on studying the feasibility of an experimental 1000-sq-ft solar air heater. The air would dry candy.



24 New South Coast steam plant of PRWRA will have two 40/44-mw preferred standard turbines; No. 1 to start running in Dec 1957, No. 2 in Dec 1958

25 Mayaquez gas-turbine station will have units identical to those shown here in Livorno station, Italy; *l to r*, 2 combustors, h-p turbine driving h-p compressor, l-p turbine driving l-p compressor, generator and exciter; intercooler is under floor



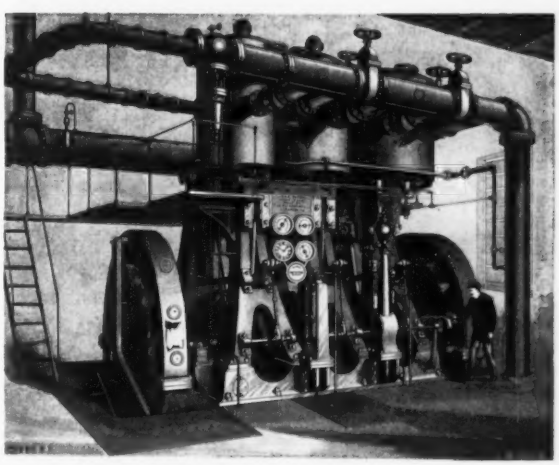
World's largest boiler in 1890... and today's, dramatize the...

Rapid pace of power progress

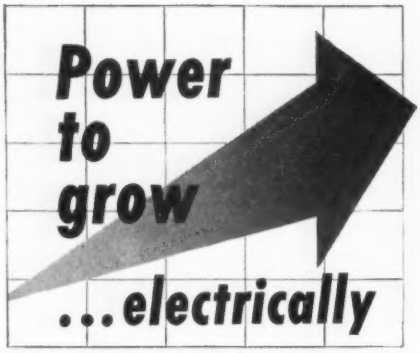
► BACK IN 1890, when POWER was a lusty 8-year-old, the boiler pictured at the left, above, was believed to be the world's largest. Located in the Westinghouse Electric Light Plant at West 24th Street, New York, it was rated to deliver 30,000 lb of 200-psi steam per hr.

The steam-generator to be installed at the new Breed Plant of Indiana & Michigan Electric Co, on the Wabash River south of Terre Haute, will deliver nearly 100 times as much steam—2.9 million lb per hr. At the supercritical pressure of 3625 psi, and 1050 F, steam from this unit will spin the largest turbine-generator yet built, rated at 450,000 kw.

Although not the world's largest, the engine-generator pictured at the right was an advanced design back in 1891 when it was installed at the 26th Street Station of the Edison Company, in New York. With double-acting cylinders of 18, 27 and 40 in. respctively, and a 30-in. stroke, it turned at a handsome 130 rpm to drive two 200-kw dynamos. The POWER article describing it spoke of its compactness: We estimate it produced just under one kw per sq ft of engine-room floor area. The Breed unit develops approximately 24 kw per sq ft of turbine-room area.



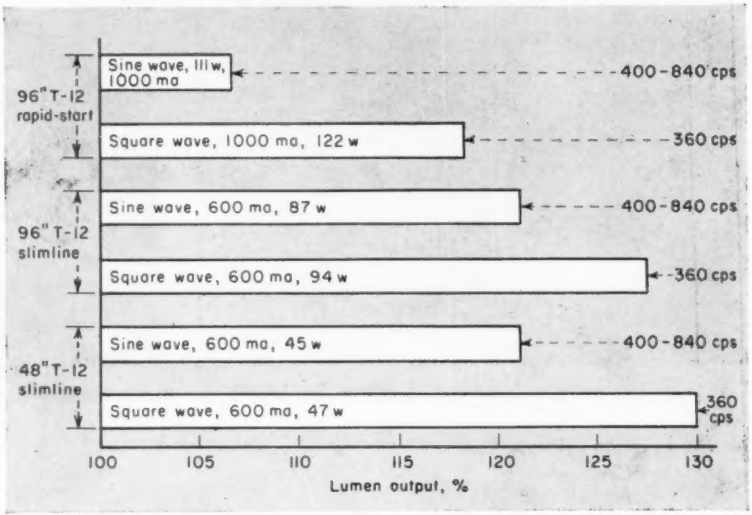
1891 ENGINE-GENERATOR. Central-station triple-expansion unit turned at 130 rpm to drive two 200-kw multipolar dynamos



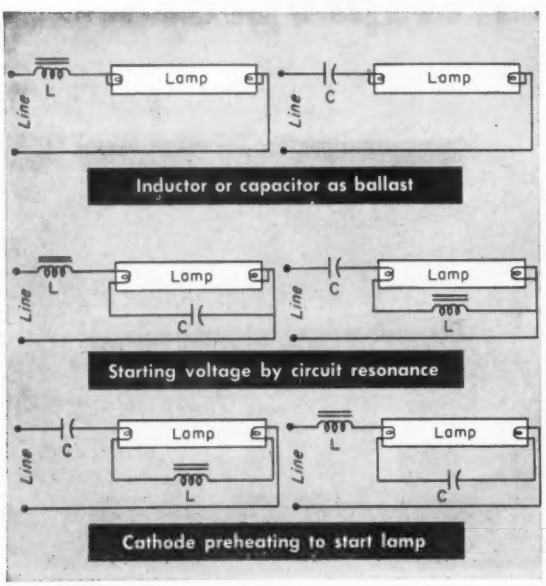
NO. 7: HIGH-FREQUENCY LIGHTING

High-cycle lighting:

High-frequency lighting is racking up new highs in efficiency, low installation costs and measurable operating savings. Here are the latest field-facts to guide your PTG plans



LUMEN INCREASE in percent of 60-cycle ratings are shown. Lamps operated at a high-current density with sine and square wave supply. Ballast size, weight, loss, are held under that of 60-cycle units. The 90-in. T-12 high-output rapid-start lamp is at optimum 60-cycle with 800-ma



TYPICAL CIRCUITS in use today for high-frequency lighting. Components materially smaller than similar units at 60 cycle

High-cycle cuts air-conditioning load

An increasing factor in determining air-conditioning capacity is the compensation needed for heat developed by lighting load. *Remember:* Heat generated by any light source is proportional to the energy consumed.

One watt-hour of power consumed produces 3.414 Btu's of heat. Tons of air conditioning needed for lighting load is figured by dividing total Btu's developed per hr by 12,000. *Example:* Total tons of air conditioning required equals the total lighting load wattage (including the auxiliaries) times 3.414, divided by 12,000.

In one specific industrial area, 15% added air-conditioning tonnage was needed to compensate for the high-output rapid-start lamps compared to a high-frequency system . . . and 20% more in stacking a standard slimline scheme against a complete modern high-cycle lighting system.

With cost-per-ton of air-conditioning equipment installed varying from $500 to $1000, a high-frequency lighting design may account for measurable saving.

Will it play a part in your PTG planning?

► IN A SMALL MEETING ROOM of New York City's Sheraton-McAlpin Hotel a few weeks ago, some of industry's key electrical engineers gathered to get the latest thinking on high-frequency fluorescent lighting. Sophisticates in the field were well aware that operation of fluorescent lamps at frequencies above 60 cycles has been tried in recent years. So this session, coming as part of the AIEE Winter General Meeting, served as a review for some, a primer for others.

Keynote paper, delivered by J H Campbell of General Electric, painted with both broad and fine brush the general picture of high-frequency fluorescent lighting development and application. Numerically there are few applications to date. Installations include a plant growth area, university field house, office buildings and industrial plants.

From 1886 to 1890 a common distribution frequency was 133 cycles. Now, on-the-spot conversion is practical way to get high cycle

High-cycle lighting is backed by a long series of experiments with lamps, ballast circuits, frequency converters and distribution circuits. Early work was done when it became obvious that improvements in size, weight and cost would reach the point of diminishing returns on 60-cycle power. Frequency converters have been designed to supply 360, 400 and 840 cycles. Although advantages in lamp operation can be shown for frequencies beyond the 840-cycle figure, economics of converter design and distribution costs have dictated the practical upper frequency limit, according to Campbell.

In the period from 1886 to 1890, 133 cycles was a common distribution frequency. This came about since early alternators had eight poles, turned at 2000 rpm. Today 60-cycle frequency can be changed to advantage at load point.

Why high-cycle? To get a proportioned view of high-frequency lighting pros and cons you must probe lamp characteristics and choice of ballast circuits, frequency converters, power distribution and comparative costs of light.

Lamp characteristics and choice of ballast circuits, as pointed out by Campbell, depend somewhat on the current wave form delivered to the lamp. And the two types of frequency converters now in practical use (rotary and magnetic frequency multiplier) have different characteristics. Rotary converter supplies a sine wave of both voltage and current. On the other hand, magnetic frequency multiplier furnishes a triangular voltage wave, and with a capacitor ballast output, takes the form of a square wave of current.

It's interesting to note that shorter lamps of same diameter are subject to a greater overall efficiency increase with a given frequency rise. This comes about since electrode losses are constant, regardless of length. Therefore, these losses in shorter lamps represent a larger percentage of lamp watts. It's the reduction of these losses as frequency increases that's largely responsible for the upsurge in efficiency. Lamps operating at 60 cycles have cathode drops of 10 to 15 volts, 3 to 6 anode drops and 2 to 3 volt drops in electrode filament. If all end losses of a 40-watt lamp could be eliminated, a 20% increase in lamp efficiency would result. Light output of today's typical lamps stand at 51 lumens per watt for a 20-w T-12, 61 lpw for 48-in. T-12 slimline, 68 lpw for 96-in. T-12 slimline.

But lamp efficiency increase with greater frequency is only one phase of the overall picture. *Example:* Lamps at 400-cycle sine wave can be loaded greatly without sacrificing lamp life. This makes further increase in luminaire light output practical. More field testing is needed before final life ratings can be attached to various size lamps operating at higher loadings. Chart, facing page, shows lumen increase for typical lamps based on percentage increase of 60-cycle rating. Lamps were operated at higher current densities with sine wave and square wave supplies.

Increased lumens per foot of lamp, shown on this table, were obtained by loading to higher levels while ballast size, weight and cost were held considerably under that for 60-cycle ballasts. The 96-in. T-12 high-output rapid-start lamp is near optimum loading at the 60-cycle rating of 800 ma and 105 watts. Square wave operation, with its higher efficiency, shows a 19% lumen gain at 1000 ma, 122 watts.

Current limiting of fluorescent lamps is handled by inductive reactance, capacitive reactance and resistance. At the lower frequencies (25, 50 and 60 cycles) ballast is generally a combined inductive and capacitive reactance in series with lamp. Straight-resistance ballasts are limited to dc applications and special ac applications where weight and space is a limiting factor. Relatively high loss in resistance ballasting is the main objection to general application.

At 300 cycles and above, a reasonably good current wave form permits use of capacitor ballast. Capacitor serves as a current-limiting device, is light weight, boasts low loss and small size. Also, inductive reactors, where used, are considerably smaller at 400 cycles and above.

Voltage for high-frequency systems is generally either 400 or 600. Final choice hinges on lamp's starting voltage. Campbell brought out the fact that wiring costs decrease as voltages increase. So the 600-v system with 300 v to ground, possesses some obvious advantages. This higher voltage also permits starting of any length of slimline lamp, rapid-start or the new GE *Power Groove* of T-12 and T-17 diameter.

Right now experts disagree on optimum frequency for lamp operation

Optimum frequency for lamp operation is a point not yet fully resolved. Lamp efficiency increases as frequency increases to about 10,000 cycles. However, according to Campbell, the greatest reduction in ballast size and weight comes at about 300 cycles. At this point the capacitor ballast becomes practical. *Example:* If 96-in. T-12 lamps are ballasted solely by capacitors at 400 cycles, ballast weight is reduced by 92% compared to the smallest 96-in. T-12 60-cycle inductive ballast. And at 3000 cycles weight reduction comes to about 96%. This advantage, at a specific frequency, fails to hold for all system components. Final choice of frequency must consider system economics including converter, panel, switches, wiring and ballasts.

Converters considered today, according to Westinghouseman J L Winpisinger at the same meeting, fall into the 400 or 800 cps category. At lower frequency a 3-phase 6-wire self-excited generator is often the power source, driven by a 3-phase 60-cycle induction motor. Generator is usually 30 kw at 80% of lag or lead. At the higher 800-cps frequency a 3-phase 6-wire permanent-magnet generator is directly coupled to an induction motor.

Permanent-magnet converter is smaller, lighter weight

and lower in cost. Since there are no brushes, slip rings, voltage regulator or field excitation equipment, maintenance is simple. But bear in mind, rotor removal for bearing replacement or other maintenance is more difficult with a permanent-magnet machine because of attraction between rotor and stator.

Permanent magnet generators show promise as high-frequency converters

Both generators have individual phase windings with grounded center taps, sketch right. This hookup provides 600 volts between either outside phase conductor and ground. According to Winpisinger, permanent-magnet converter efficiency is 3 to 5% greater than the self-exciter unit. Winpisinger proposes the 800-cycle system as offering lower initial cost and operating expenses.

Air-conditioning sizing in both new and renovated buildings is affected by amount of heat developed by the lighting system. Total heat of any light source is in direct proportion to its energy consumption. One watt-hour consumed produces 3.414 Btu's of heat. Tons of air conidtioning needed in any given area is determined by the total Btu's per hour divided by 12000. So total tons of air conditioning required to compensate for lighting load is the total lighting wattage, including auxiliaries, times 3.414 divided by 12,000.

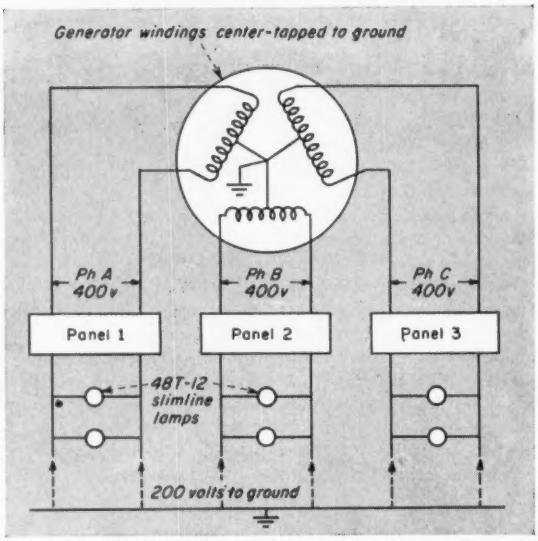
Winpisinger takes as a case-in-point an industrial area where 15% additional air-conditioning tonnage is needed to compensate for a high output rapid-start system compared to a high-frequency setup. In same analysis, 20% more air-conditioning tonnage was needed, using a standard slimline system stacked against a high-cycle scheme. And, as Winpisinger points out, with cost per air-conditioning ton in the order of $500 to $1000, a high-frequency lighting system can build up a considerable savings not ordinarily included in a lighting-cost analysis. In addition to the initial cost advantage, annual energy cost for air-conditioning operation would be less with high-cycle lighting.

Reduced wattage load, air-conditioning savings and lower wiring costs are but part of the story. To replace the heavy 60-cycle 2-lamp ballasts with a small capacitor for each lamp means about a 25% weight reduction for each lighting fixture. Capacitor ballasting trims hum—sometimes a serious drawback to fluorescent lighting. Tomorrow's luminaire designs may use lighter metals to further reduce weight.

On the negative side, keep in mind that present generators run about 80 to 85% efficient, pointing up a 15 to 20% penalty for making the high-cycle power available. And the generators must be on the line, dissipating power losses even though few lamps are needed. As it is a rotary piece of equipment, some maintenance must be expected.

Electrical size of available converters does not always allow the most economical lighting layout for a given area, because of partial loading. Standby units become a must for maintenance unless downtime can be tolerated. Also, generator noise and physical size call for installation in some remote vault or room. Where large numbers of small lamp groups must be switched on and off the generator bus, consider the added cost of complex switching and wiring.

Magnetic frequency multiplier has no moving parts and can be installed similar to a transformer. According to Campbell of GE, available panel control makes current regulation to the lamp possible with maximum flexibility. This power supply yields a triangular voltage wave so lamps operate on a square current wave with individual capacitors as ballasts. Some special applications of this system have been made. Right now the unit is only available in a 5-kw size, posing a relatively high cost per kw. Generators rated



400-V, 840-CYCLE distribution in Wakefield Bldg used a 6-circuit panel arrangement; generator midpoints are grounded

High-cycle distribution calls

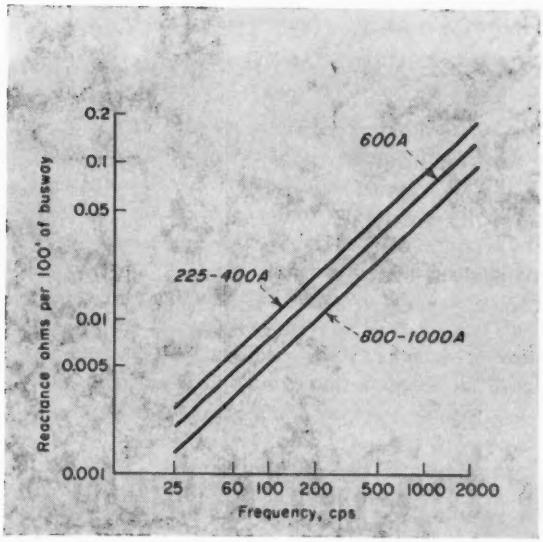
25, 50 and 100 kw have been specifically designed, according to Campbell, to meet the requirements of fluorescent lighting loads. It is quite possible that rotary frequency converters can be designed to generate a triangular voltage wave form, providing lamps with the advantageous square wave current.

High-cycle power has seen service for some 50 years. According to V C Geckler of General Motors at the same meeting, the New Departure Division of GM in Bristol, Conn. developed their first application of 300-cycle power back in 1904.

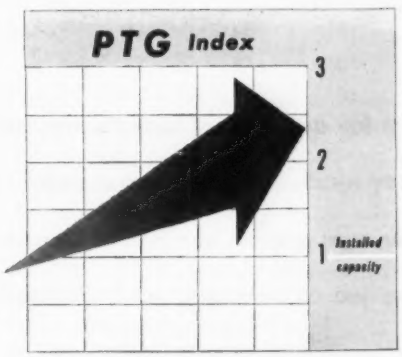
Power distribution of high frequency, in sizable amounts over any distance, poses some problems because of higher reactance loss. Reactance increase at frequencies above 60 cycle is about proportional to the frequence increase. *Example:* A distribution line made up of three conductors at 60 cycle with a reactance of 0.005 ohms per 100 ft will have a reactance of 0.01 ohms per 100 ft at 120 cycles. So reactance of the line, rather than resistance, is the dominant factor as system frequency is increased.

Geckler brought out the skin-effect angle, noting that as frequency increases cable skin-effect increases. Through skin-effect, current tends to flow in outer layers rather than in conductor center. Knowing these facts, the PTG problem becomes one of planning for high-cycle power distribution, yet remaining within the 3% voltage drop limit. Three solutions were proposed: (1) Run a parallel 3-conductor separated line connected at both ends. All conductors would be the same length and size. (2) Use a 3-conductor cable within a single enclosure, thus placing all conductors in close proximity to reduce line reactance. (3) Distribution might well take the form of concentric cable with one conductor in center, other on outside. Three such conductors properly phased are effective in trimming reactance.

At frequencies to 1000 cycles there should be little dif-



HIGH REACTANCE LOSSES in busways hold high-cycle distribution by this method to minimum. GM uses 30-ft maximum run



What is your PTG index?

By tagging installed capacity as unity, PTG index gives some measure of a system's expansibility. We define the PTG area as the planned-for-capacity that can be economically added to existing system

for derating key equipment plus providing for higher reactance loss

ficulty in running such lines in conduit. Steer clear of busway for high-cycle distribution over 30 ft. Bus-bar spacing within the duct contributes to a high reactance.

Controls, such as relays, line starters, disconnect switches and pushbuttons, are standard 60-cycle gear used at the higher frequencies. But a derating factor is important to prevent overheating. *Remember:* Devices that open or close all phases of a high-cycle circuit should be derated. This includes fuses in disconnect switches. Generally speaking, the interrupting capacity of circuit breakers and disconnect switches are not affected by high frequencies. Check manufacturer's recommendations on this angle before applying such equipment. Makers of available equipment can be most helpful in supplying application data for high-cycle installations.

Capacitors as lamp ballasts permit more flexibility in control of lamp brightness

An office building, planned recently and discussed by R H Burnham of the Wakefield Co at this AIEE meeting, drove home some of the practical aspects in designing high-cycle lighting into a specific job. Area being planned tallied 5000 sq ft with a lighting load of about 35 kw. A luminous ceiling was planned, incorporating lighting, acoustics and air diffusion.

Use of capacitors for lamp ballast allowed a good measure of flexibility in lamp brightness. Light output can be increased or decreased by swinging to a different value of capacitance. This technique came in handy to provide even lighting in areas with different lamp spacing. Of the known means of frequency conversion, the m-g set promised most reliable service at reasonable cost. Here the higher maintenance risk of rotating equipment with permanent magnet rotor was chosen over the higher initial cost of the static frequency multiplier or the high maintenance cost of the straight electronic multiplier.

Burnham's investigations for this job were made at 360, 400 and 3000 cycles. Even though circuit components become smaller and less costly as frequency increases, the higher cost of conversion and difficulties in transmission pointed to a compromise at 840 cycles.

Since an improved wave shape has a good effect on lamp performance, generator design is aimed at creating a square current wave flowing through the lamp. Burnham claims that in the area beyond 300 cycles, wave shape has more influence on lamp performance than an increase in frequency.

Here, 400-volt distribution was adopted, sketch p 88. Each phase passes through a fused disconnect switch to a distribution panel at one of the three load centers. Each such panel has six circuits. Circuit protection is handled by cartridge fuses with indicator glow lamps. Wiring consisted of No. 6 type TW feeders and No. 12 TW branch circuits.

Cost picture favored the high-cycle scheme compared to a straight 118-v 60-cycle job. The dollar savings in wiring for this 35-kw load totaled $1840 in adopting 840 cycles, 400 volts. This saving, plus first cost saving in smaller air conditioning, plus cost difference between capacitors and ballasts, came to more than the cost of m-g set and pf correction coils.

Higher efficiency and greater flexibility dropped power consumption 20% over the comparable 60-cycle system. And air-conditioning load was trimmed 10%. If lamp life is stretched, as anticipated, operating cost will be cut further.

Your PTG angle comes in probing merits of high-cycle lighting for an upcoming job, either in commercial building or industrial plant. If it fails to look attractive now, consider the problems that would arise in the future should a swing to high frequency become more feasible.

To meet the demands of today's processes, boiler controls have —as they must—become more complex. But by carefully sizing up your own process needs, you can get a control system that does its job economically and efficiently

Boiler controls — for top performance key them to your process demands

► As present-day boilers grow larger and more complex, their control systems must follow closely in the same path. Even the old-pro systems designer is often awed by the maze of components required to control the modern boiler efficiently. Yet, if we view these systems in terms of their several functions, the pieces fall neatly into place.

System requirements. First, a boiler control system must maintain furnace heat input at a level comparable to the heat added to steam, plus boiler heat losses. Simplest index of the relation between heat input and heat output is steam header pressure. If heat in is less than heat out, header pressure drops off proportionately. Steam pressure signals are quick to respond to load changes and indicate errors in the ratio of heat in to heat out.

Second important job of the boiler control system: It automatically controls fuel-air ratio in the furnace. This is a key factor in getting best firing conditions. To pin down the best ratio we take into account (1) excess air (2) unburned carbon in the ash (3) smoke (4) high furnace-temperature. *Example:* In coal firing, low excess air in the furnace must be weighed against possible ashpit losses and furnace temperature. The latter two items are excellent yardsticks of furnace maintenance.

Third requirement: Keep furnace draft at the right level. Draft in the furnace should be as near to a balanced condition (atmospheric pressure) as boiler operation permits. If draft is too high, air infiltrates. Air that leaks in usually doesn't mix with the fuel in a ratio that's suitable for combustion. Most of it builds up in layers with the flue gas. Thus air leakage only adds to boiler heat losses. Not only does this extra quantity of *air* require heating to the exit gas temperature, but its extra weight adds load to the induced-draft fan. Also, increased mass flow through fixed boiler cross-sections ups gas velocity. *Result:* Either steam production suffers or control system calls for more fuel.

Positive furnace pressure does not seriously affect boiler performance as long as pressure doesn't stray too far from atmospheric conditions. But hot-gas losses from a furnace under pressure could easily damage unprotected boiler parts, blow ash and soot to the surrounding atmosphere. And even worse, escaping gases are an operating hazard.

If the furnace is designed for pressurized operation, the boiler manufacturer has designed a pressure-tight unit. The unit requires no furnace draft control unless a negative furnace draft is needed during startup or emergency operation.

Feedwater, steam-temperature control systems are closely related to the combustion control system. Poor feedwater control upsets the ratio of water flowing into the boiler drum to steam leaving the drum. If the error is substantial, heat pickup per pound of steam isn't constant. Combustion controls try to correct the error. Since feedwater fluctuations generally result in a faster response signal than combustion controls could compensate for, system may cycle severely.

Steam-temperature variations also affect combustion-control operation. As heat content of steam varies (because of steam temperature fluctuations), system may cycle in much the same way as with poor feedwater control.

Safety equipment must be completely isolated from meters and controls. Don't use same primary measuring elements for both control and safety equipment. If the primary element fails, you lose all metering, control and safety features. The same goes for safety shutoff equipment. Isolate it from the controls. *Reason:* Continuously modulating control units generally aren't designed for *tight* shutoff in case of failure.

Control selection. Matching boiler controls to the characteristics of overall plant design takes careful planning. Maximum steaming rate, type of load (from load curve), fuel available and operating conditions are among the more important items to be weighed.

Plant's design capacity largely dictates the economical investment. Fuel supply also depends on capacity. And since larger units require more fuel they generally warrant complex fuel-air ra-

A quarter century of boiler-control progress

The past 25 years have seen a gradual, but continuous development of industrial instrumentation and combustion controls. During the early 1920's the average boiler was equipped only with the bare essentials from the instrumentaiton viewpoint. A steam pressure gage, underfire pressure and draft indicators—and in some instances a steam-flow air-flow meter—provided the sum and substance of the control system. Automatic combustion controls were in their embryonic stages. Only the most modern central stations and industrial plants had control systems. And even these were remote *manual* control systems.

Then along came the depression years of the 1930's. And, surprisingly, these proved a spur for development of controls. Industry recognized that automatic controls would mean more efficient fuel burning and reduction in manpower, operating costs.

Rapid strides during the late thirties and early forties were geared to the mushrooming manpower shortages and fuel scarcity caused by the war effort.

After World War II the trend toward complex control equipment continued. Direct production competition, as well as the need to further reduce boiler operating costs, were caused largely by the sharply rising wage spiral and the surge of higher prices. Clearly, the trend to even more complex controls prevails today and moves foward at an accelerated pace.

tio controls to realize full savings potential from the fuel-burning process.

Now let's see how load *type* enters the picture. Steady load is usually a pretty good indication that only minor control adjustments are required to maintain the right heat in-out ratio. Steady load characteristics simplify controls even for large boilers.

In contrast, loads that peak or dip rapidly point up a need for complex control equipment to hold steam pressure and heat in-out ratio stable.

Control actions. POWER, Feb 1957, pp 98-101 talked about the details of controller actions. Here we'll see, in brief, how they apply to combustion controls. The basic master controller actions are (1) two-position (2) proportional (3) proportional plus reset (4) rate or derivative action.

Two-position controls get their master signal from the main steam header in the form of steam pressure. The master steam pressure controller, via relays, actuate valves and dampers that control fuel and air supplies to the boiler. Master controller moves the fuel and air motor operators either to their on or off positions to maintain heat input proportional to heat output.

Two-position control systems allow steam pressure to vary through a relatively wide band before a complete control action takes place. Adjustment of the master controller pegs the minimum and maximum steam header pressure needed to actuate the master regulator. To compensate for system inertia, the maximum actuating point is somewhat lower than maximum steam header pressure. Similarly, the minimum actuating point is somewhat higher than minimum steam pressure.

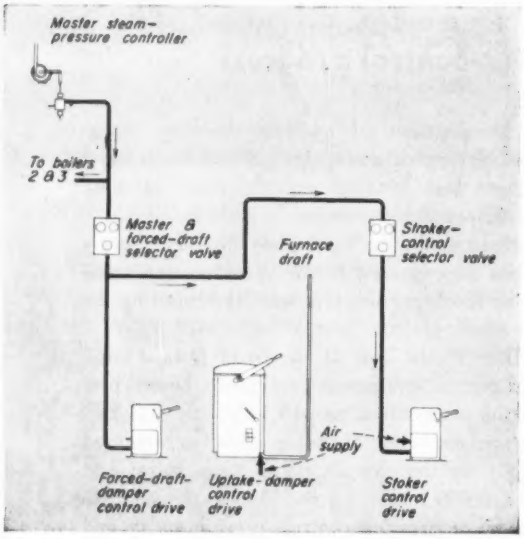
Proportional control positions fuel and air motor operators in direct proportion to steam-load changes. But inherent in the system, set point (steam pressure about which the system stabilizes) goes up as steam load dips; set point drops off as steam load climbs. Thus proportional controls work best where steam load changes are relatively small. These units are often designed so they can be manually reset to the desired set point.

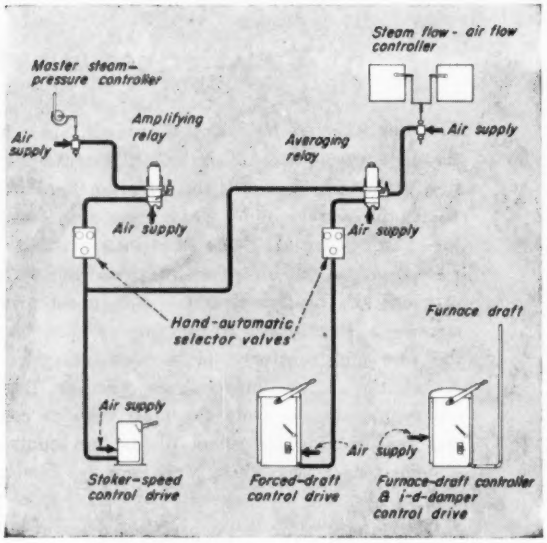
By adding an automatic reset feature to the control system, the desired set point is upset only momentarily when steam load changes. Floating action continues to reposition the motor operator until the system comes back to its original set point. Allowable set point variations and time to reset are adjustable. Usually we choose a relatively slow reset time, to keep steam pressure from cycling about the set point.

Master signal control of the variables (fuel flow, air flow) can be handled in series or parallel operation. In series operation, the master signal positions one or more of the primary variables. A second controller then senses the master controller change and repositions the remaining variables. Parallel operation positions all variables from the master signal at the same time. Usually, parallel control hookups best fit the needs of complex boiler systems.

Final selection of any combustion control system depends on the variables involved in each case. And while many types of control combinations will work for a particular installation, one type will be safest, give closest control consistent with the justifiable investment. If you're charged with the responsibility for combustion control selection, it'll pay you to keep close tabs on all available systems. And remember, new techniques are constantly being developed in this fast moving field.

Rapidly fluctuating process demands generally dictate proportional-plus-automatic-reset control actions. To see why, let's get down to cases





1 For small, steady steam loads—a proportional controller does the job

Low-capacity steady-load systems generally need a minimum of control equipment. They can tolerate some set-point variation, simplifying overall control. Boilers as large as 60,000 lb per hr, with steady loads, usually need simple parallel controls actuated by a proportional-action master controller.

Hookup, top left, fills the bill for a low-capacity (less than 25,000-lb-per-hr) boiler serving a relatively steady load. Normal output is about 80% of maximum boiler capacity. Since steam is used mainly for heating purposes in a process that has large heat-storage capacity, some steam-pressure variation is tolerable, even if a major process load change occurs.

Overall fuel savings that the plant could realize with automatic fuel-air ratio control equipment probably wouldn't be enough to justify installation. Fuel for the system is coal, burned on an underfeed stoker.

A review of the plant's process conditions showed that parallel proportional control would meet boiler needs. Manual adjustment with panel-mounted selector stations could easily be used to correct fuel and air flows to keep air flow closely following steam flow on the boiler meter. Thus the system maintains a close fuel-air relation.

Further study of boiler conditions showed that floating controls (automatic reset) would maintain a steady furnace-draft set point for the unit.

System, top right, is a typical medium capacity industrial design. The plant manufactures parchment products and, because of process characteristics, load variations are relatively wide. Boiler burns coal on a chain grate stoker.

Considering load fluctuations and close steam-pressure set-point requirements dictated by the process, the controls had to be more refined than those at left. Proportional control of the motor operators that position fuel and forced draft to follow the boiler load are needed. But to get faster response and closer steam pressure limits, engineers gave the nod to automatic reset for the primary master controller.

This unit was designed for 90,000 lb per hr. Thus fuel savings from automatic adjustment of fuel-air ratio is substantial. But a second factor also points to automatic fuel-air ratio control: The *nature* of the fuel-burning operation. Right balance of fuel and air supplied to a chain grate isn't too difficult but it takes careful design to get the right control responses. If fuel-air ratio varies, combustion efficiency changes, so a constant fuel-air ratio is important. With too much fuel supplied to the furnace, fuel bed becomes too long. Ashpit losses are excessive. If too much air reaches the furnace, fuel bed shortens and, if load demand increases, the furnace doesn't contain enough heat to maintain required steam pressure. Also, heat loss is high because of too much excess air. The master steam-pressure controller tries to compensate for the error by correcting fuel input to maintain steam pressure at the desired level. This might result in some cycling of the control system.

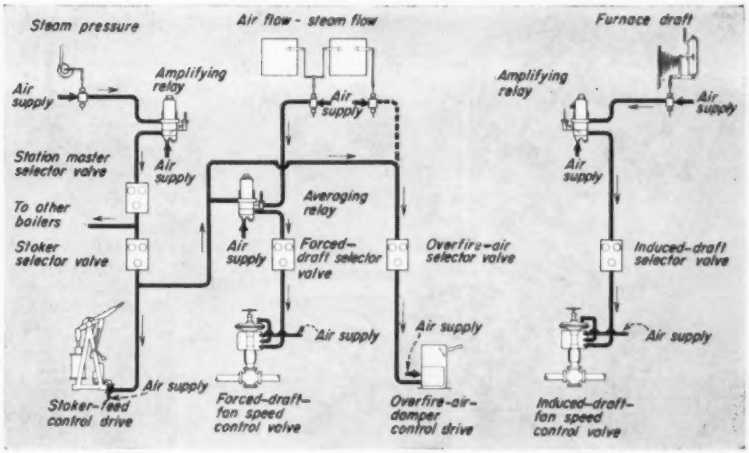
2 For fluctuating steam loads—automatic fuel-air ratio control

By specifying proportional plus automatic reset control action, fuel and air supply changes rapidly, and in amounts required to hold required steam pressure. An automatic fuel-air ratio adjustment signal from the boiler meter is averaged with a control signal from the master controller. Combined signal controls the f-d-fan damper drive. Minor adjustments are generally needed to hold the fuel-air ratio at right levels and to maintain correct fuel bed conditions. Net result is a more stable, efficient control system.

Firing more than one fuel. Occasionally the operating characteristics of even small plants require highly sensitive controls. A small process (heating paint chemicals for instance) may require a constant heat level from saturated steam. Because of close tolerances on steam pressure, a proportional plus reset action controller might be essential. It would include automatic fuel-air ratio control and, if boiler fires byproduct gas together with its base fuel, the system may also feature a fuel-air ratio *recorrective* control.

For burning byproduct gas together with fuel oil, a fuel limiting correction on oil flow to the furnace, proportional to gas flow, is good practice. Measuring gas header pressure ahead of the gas regulating valve, is a simple index of gas availability. Here too, fuel-air ratio recorrection is vital.

3 For spreader-stoker firing—close furnace-draft control



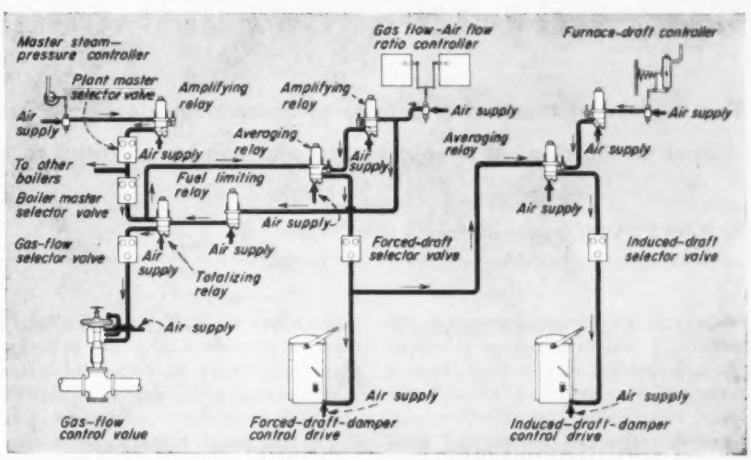
Combustion control hookup at right is for a relatively low-capacity unit with a sharply fluctuating load. Steam flow is about 50,000 lb per hr. The unit burns coal on a spreader stoker.

Here too, process conditions call for close control of steam pressure. And good fuel-air ratio control is economically justified. The job master controller must do calls for proportional plus reset action.

Overall fuel savings resulting from automatic fuel-air ratio control is substantial in this case. But maintaining furnace heat storage at its correct level complicates the picture. Here's why: The spreader stoker is fast to respond to a master control signal but little live fuel storage is available in the furnace at any one time. From this viewpoint the spreader stoker presents problems much like those we associate with pulverized coal, oil or gas firing. Thus, automatic fuel-air ratio control usually gets the nod. Here, as in all cases of automatic fuel-air control, the ratio controller acts as a vernier readjustment of fuel-air rate. The master steam pressure controller performs the major control signal changes to the motor operator that positions the forced-draft speed control. Result is high accuracy.

Close furnace draft control is important when you fire coal on spreader stokers. To hold the right furnace draft set point, the system uses a separate furnace draft controller working in series with the master steam pressure controller. The furnace draft controller also features automatic reset action.

4 For a large industrial —parallel control of fuel, f-d, i-d

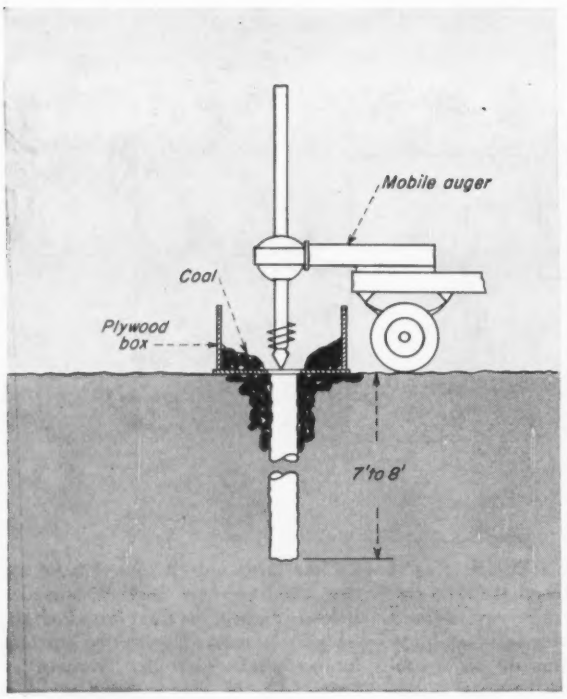


Typical of combustion control installations for large gas-fired industrial boiler plants is the system at right. Boiler steaming capacity is about 275,000 lb per hr. Load demand varies some 20 to 50% from maximum load conditions in a matter of seconds. So a highly sensitive and fast response control system is a must.

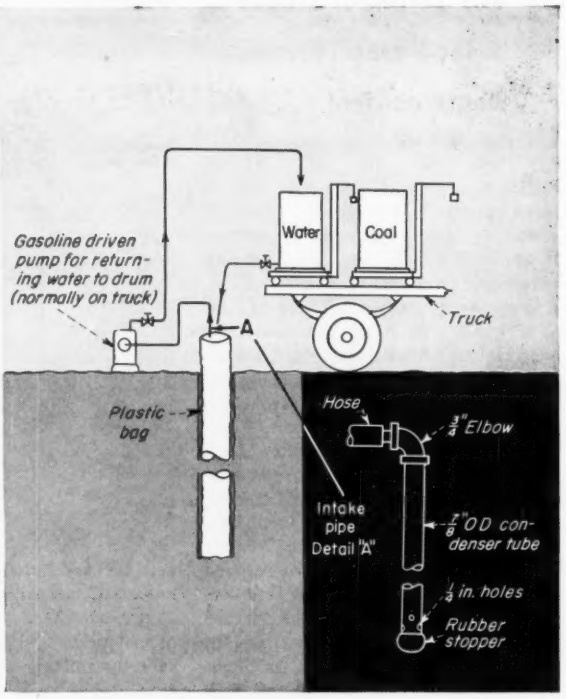
System designers, recognizing rigid process requirements, decided on a combination of control elements. The system controls fuel flow, forced draft and induced draft in parallel.

With sudden load change, gas feed to the burners is rapid. So designers had to gear the system to the possibility that the forced-draft fan couldn't supply air fast enough. Thus, with the gas-flow motor operator positioned from the master controller, a limiting signal from the fuel-air ratio controller retards gas flow to the burners. Net effect of the arrangement: Gas flow closely follows air flow. Also, the fuel-air signal can be superimposed on the final control signal to the forced-draft operator. By using two opposite but corrective signals in this way, gas and air supplies stay within close limits, control is more stable and system operates safely and efficiently with lower excess air.

Without parallel control of induced draft along with fuel and forced draft, designers anticipated substantial furnace draft upset. So a separate furnace draft controller measures deviation from the furnace draft set point and corrects the error by repositioning the induced-draft control drive.



MOBILE AUGER digs into coal pile through hole in center of sample-collecting box. All coal removed can then be weighed



VOLUME OF COAL removed is measured by calculating volume of water to fill a long plastic bag set into the test hole

One way to measure coal-pile density

This method of measuring density gives an average figure for both the surface coal and that deeper in the pile. It is easy to use and can be adapted to any plant

By **JOHN E DAVIS**, *Indianapolis Power & Light Company*

► GETTING AN ACCURATE FIGURE on the amount of coal in a storage pile need not be a problem. The method of measuring density described below, combined with results of a coal-pile survey, lets you calculate tonnage on hand quickly and easily. Here's the equipment we use, and how we do the job.

Equipment. We use a mobile earth auger with a 9-in. bit (borrowed from our line department); a 1½-ton truck; two 1000-lb platform scales; two 55-gal drums; one gasoline-driven pump; one plastic bag with 12-in. diameter, 9-ft long; one box, 4-ft square, 2-ft high, with 11-in. hole in center of the bottom (to collect coal dug by the auger).

Drums are set on the scales, which in turn are set on the truck. One drum and scale is used to measure coal; the other, to measure water. We welded a nipple and valve at bottom of water drum to make it easy to withdraw the water.

The long plastic bag is made of sheet material purchased at the local dime store. This type of plastic is normally used for tablecloths. We fabricated it into a watertight bag by overlapping the material, covering it with a pressing cloth and applying a household iron set for "wool." We used about double normal ironing pressure, applied heat for about 10 seconds. *Caution:* Don't put iron directly on the plastic as it will melt.

Test method. First, put the coal-collecting box in a level spot on the pile. Then move up the auger and drill through hole in the bottom of box.

Start the auger slowly and lift out small quantities of coal for the first foot or so. Drilling too fast at first enlarges the top of the hole and makes coal "heave up" around it.

When depth reaches 7 or 8 ft, remove auger and transfer coal from the box to the drum on the scale.

Next, tamp bottom of the hole to firm up coal disturbed by the auger and compact any spills. Then put the plastic bag in the hole and fill it from the water drum. Allow water to stand a few minutes and check for leaks.

Weigh the water before and after filling the bag. Difference is weight of water in the hole. Also measure water

White River coal pile density checks

	TEST HOLE									
	1	2	3	4	5	6	7	8	9	10
Water										
Gross weight	448.5	432.5	429.0	427.5	424.5	422.8	420.8	414.0	414.0	409.7
Tare weight	292.0	281.5	264.5	262.8	236.2	241.0	236.0	243.0	236.5	234.7
Net weight	156.5	151.0	164.5	164.7	188.3	181.8	184.8	171.0	177.5	175.0
Temperature, F	65	67	70	71	73	78	79	81	83	83
Density	62.34	62.33	62.30	62.30	62.28	62.23	62.22	62.20	62.19	62.19
Volume, cu ft	2.51	2.42	2.64	2.64	3.02	2.92	2.97	2.75	2.85	2.81
Coal										
Gross weight	223.0	213.5	232.0	232.0	250	252.1	257.8	240.0	247.5	246.0
Tare weight	37.5	38.0	37.5	36.5	37.5	37.5	38.0	36.7	37.5	37.5
Net weight	185.5	175.5	194.5	195.5	212.5	214.6	219.8	203.3	210.0	208.5
Density	73.90	72.52	73.67	74.05	70.36	73.49	74.01	73.93	73.68	74.20

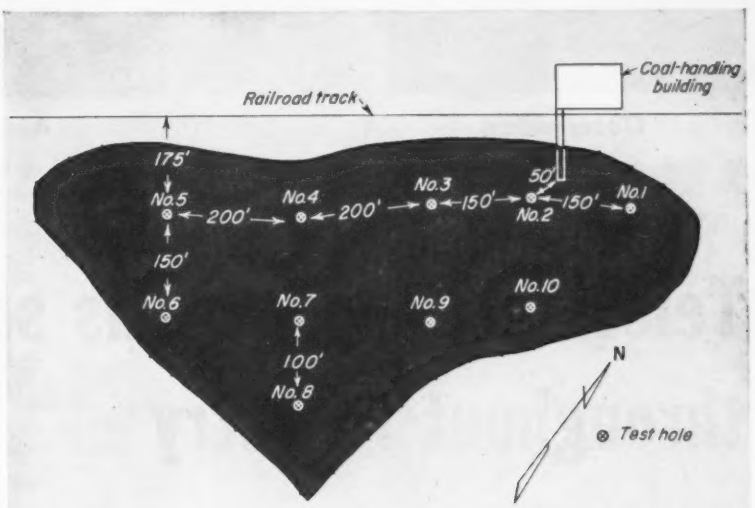
Average density: 73.38 lb/cu ft

Test results

Using the equipment pictured on facing page, we took samples at about 150-ft centers, covering the entire coal pile. Sketch at right shows how measuring points were distributed. System can be adapted for any shape storage pile.

Results of measurements and calculations, above, showed that average density in our White River coal pile was 73.38 lb/cu ft. Tests on our Harding Street storage pile (not shown) indicated about the same density. The figure there was 73.08 lb/cu ft.

We feel that the results obtained in these tests are as accurate as we can get. Taking a sample down to a depth of 7 or 8 ft gives a better figure than would be possible by sampling only the coal near surface of the pile.



White River coal density check points

temperature as it affects density. Use weight and density of water to figure hole volume.

Then pump water back into drum to be used at the next test point. Returning water to the drum also provides a double check on leaks.

When you know the weight of coal removed and the volume of the hole, figure coal density by dividing weight by volume, chart, above.

Take care when inserting the pump suction line into the plastic bag. If suction line bumps side of the bag, the sharp pieces of coal may make small tears. We used a piece of ⅞-in. OD condenser tube, 10-ft long on the end of the suction line, to reduce the chance of damage, sketch, p 94, right. This rigid tube would stand in the center of the bag, free of all sides.

Sample points were taken on 150-ft centers, covering the entire coal pile. Our test holes were about 7-ft deep with 10-in. diameters. (See plan view.)

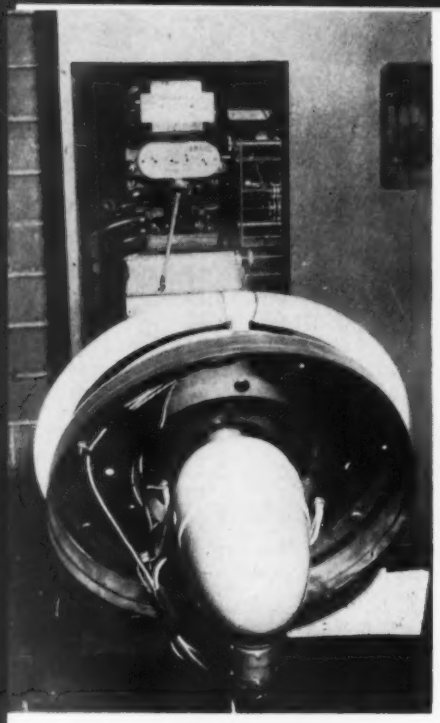
Results. On tests at our White River and Harding Street stations we found practically uniform density. (Average density at White River, 73.38 lb/cu ft; at Harding St, 73.08 lb/cu ft.) You can reduce the average density slightly to allow for small voids not filled by the bag. This error is minor, but indicates which way to apply a correction.

Conclusions. We feel that the average density obtained is as accurate as possible. This method covers the pile surface and also its depth.

Do you know...

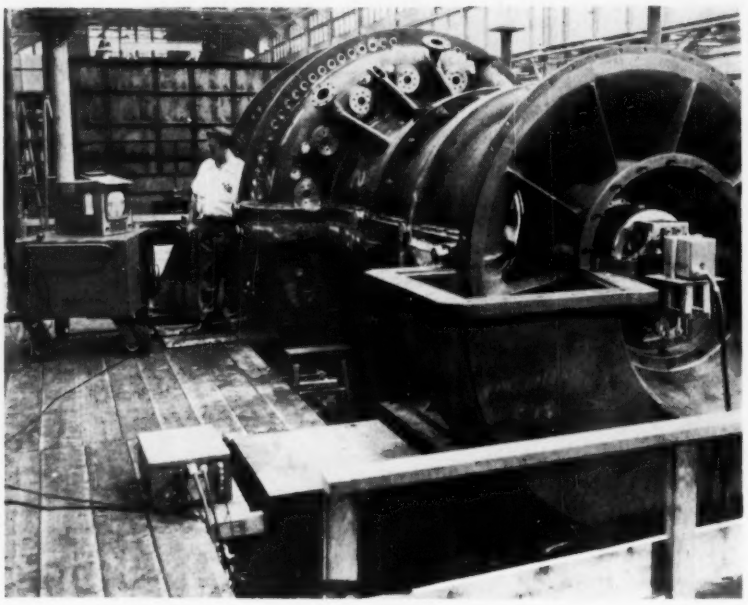
that the best way to build an outdoor coal-storage pile is in layers 2-ft thick, or less? Compact each layer before adding the next. This avoids a stratified pile, which offers easy passage for air. Good storage piling reduces air flow to a minimum to avoid spontaneous combustion, excessive weathering loss.

Probe the pile regularly to check temperature. If it gets up toward 160 F at any point, you have a bad spot. Extra compacting in the heated area may cut air flow enough to throttle the reaction. Best plan in most cases is to remove affected coal without disturbing the remainder. Spreading the heated coal usually puts out the fire.



Observation

Monitoring demand meter helps the engineer to control plant's peak power needs



Assembly

Closed-circuit TV camera helps line up sections of the gas turbine during assembly. Camera is bolted, leveled and centered on first shell, aimed at target on the next

Television applications spread throughout industry

One manufacturer estimates that industrial television will be a $10 million business in 1957, and $50 million in 10 years from now. Where is it used? Here are some of the highlights

► OBSERVATION, assembly, surveillance, hazardous work, materials handling, education and training, railroad operations, traffic control: This is one classification of the major uses for industrial television (ITV) today.

To quote another source, television is essentially an ideal means of extending the sense of vision. It permits an operator to view one or more scenes or operations simultaneously, from a more advantageous position.

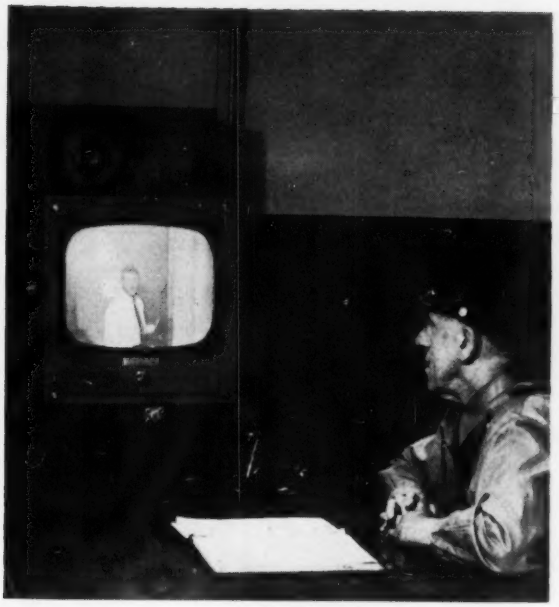
For example: A zinc-oxide products manufacturer saves $10,000 a year by using ITV to check its power company's demand meter, located in a substation some 500 ft from plant's control room. Because he is able to see the demand meter, plant engineer can control his electrical load to avoid peak power demands that would raise power bills.

Wierton Steel Co uses ITV to let operators see and control processing operations inside reheating furnaces; General Electric Co employs it to help line up gas-turbine sections; the U.S. Navy applies it to underwater salvage; Philco Corp sets it up to watch plant entrances; a mid-western school of dentistry uses TV to teach 200 students at one time; and Hanford atomic plant uses two color TV cameras to help operate a crane in a radioactive area.

Inside power plants, monitoring furnace flames, water-level gages, smoke stacks are common applications.

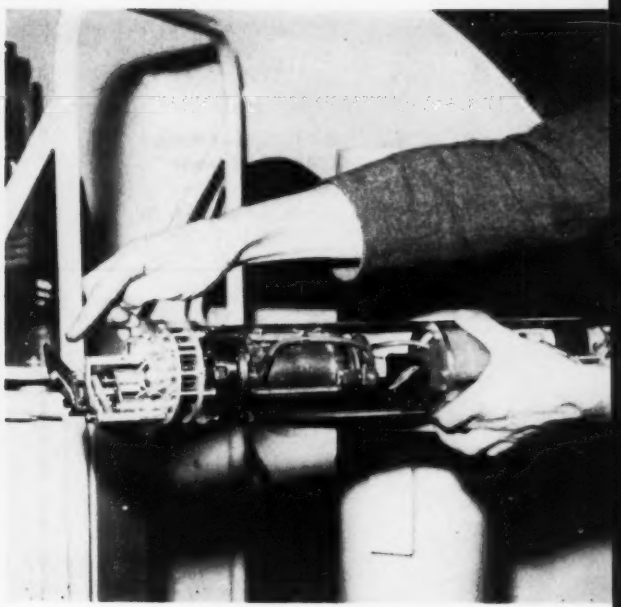
What is claimed to be the largest single TV installation is now under test in New York's Pennsylvania Station. This network of equipment consists of more than 105 TV cameras and 103 monitors. The object is to speed up the entire customer ticket-reservation-information service department.

Equipment. In general, there are two types of television equipment: broadcast, and closed circuit or ITV. The ITV equipment again breaks down into



Surveillance

Guard maintains security watch over two locations, one at his desk, the other at a doorway to a confidential plant area



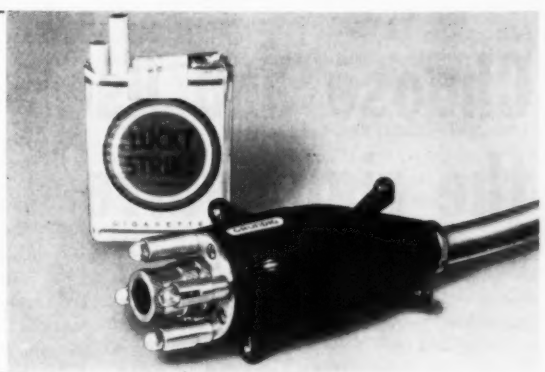
Hazardous work

Specially designed camera (casing removed) for looking into reactor. Remotely controlled mirror permits all-round viewing

Miniature camera

The ITV camera pictured at right is claimed to be the smallest in the world. It can be used for inspecting the inside of boiler tubes, with a minimum diameter of 60 mm. Developed by a German firm, it has a maximum outside diameter of 54 mm (just over 2 in.), and length of about 135 mm (under 6 in.), not including the 8 mm lens.

This special design has spring-supported guiding rolls, a lighting fixture and mirror optic. Using miniature vidicon equipment, maker says its resolution is approximately 300 lines. Unit is recommended only where standard equipment is too large for the space available.



two types: vidicon and image dissector.

Vidicon cameras generally provide the best resolution (ranging from 400 to 600 lines, depending on the manufacturer). They can be used with normal room lighting (25 to 50 ft-c, and in some cases down to 10 ft-c or less for a "readable" picture.)

Image dissector equipment provides less resolution (about 300 lines), has less sensitivity, works best with lighting levels around 120 ft-c. It can be used down to 50 ft-c. However, the manufacturer notes that this equipment needs no filament and claims exceptionally long life. Other advantages claimed are no "trailing" effect, no vibration distortion, fewer adjustments.

American manufacturers of both types of equipment have been gradually improving performance and reliability since POWER's last report on industrial television ("TV sees where you can't look," April 1953). Except on an experimental basis, they have not emphasized camera miniaturization. Dimensions of a typical camera are 6¾ x 5⅛ x 11 3/16 in. Price of basic ITV equipment (camera, control, monitor and cables) varies from $995 to about $4000. Extra features available with different units include remote controlled camera, tilting mounts, weatherproof, explosion proof, dustproof housings.

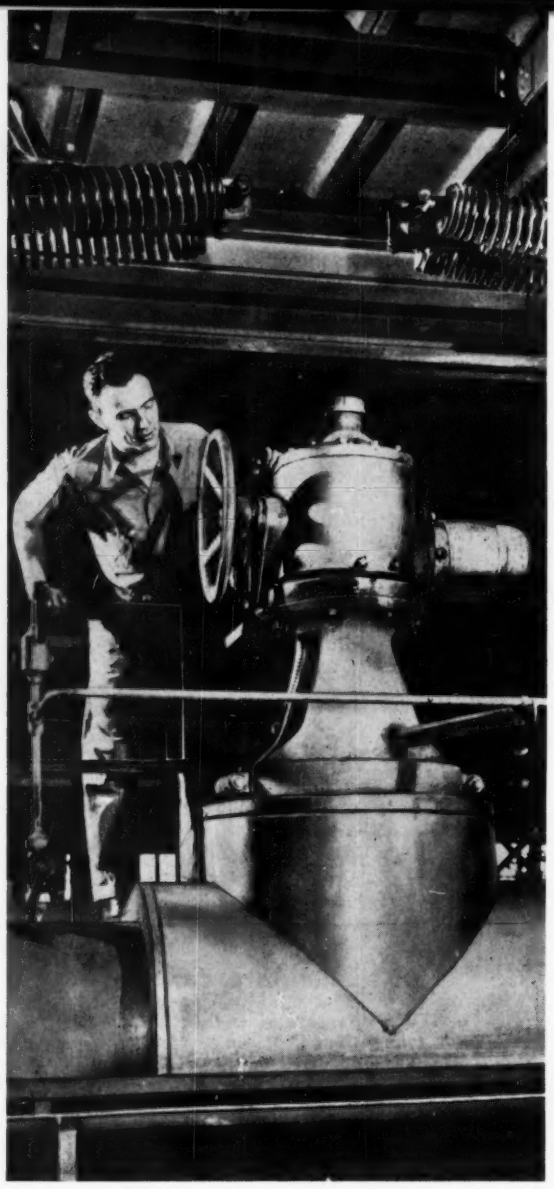
Most cameras use any standard 16-mm movie-camera lens. Generally, home type receivers can be used as additional viewers; extra cameras and switches can be used for observing more than one location. Several manufacturers now produce color equipment.

Recent European developments include the miniature camera described in box above, and a special cylindrical camera for use inside atomic reactors, photo, top right. This camera is lowered into a reactor by a cable contained in a 75-ft rubber hose.

By **H L CUMMINGS**, *Plant Manager*
H L MARSH, *Chief Engineer*
R-P&C Valve Division
American Chain & Cable Co, Inc

Do you want shutoff, throttling or nonreturn action? Here's a roundup of basic info that will help you . . .

Choose and use the right valve



PRESSURE SEALED gate valve astride a 2500-psi steam line

► LAST MONTH (pp 122-123) we talked about ten common ways that valves are abused. Poor maintenance and wrong handling were highlighted, though we pointed out that some abuse results from using the wrong valve.

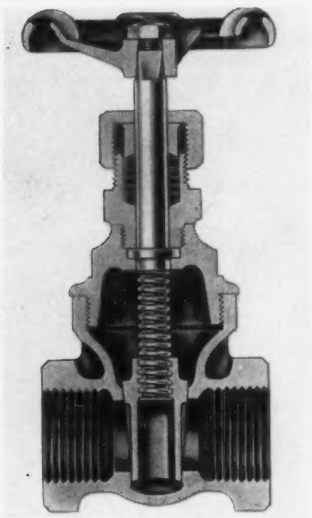
This month we're dealing with factors to consider when you're ready to select, purchase and install valves.

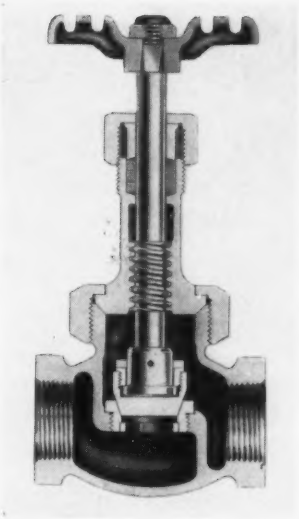
Flow volume and what the valve will handle generally determines selection. But, for correct application, you must know a valve's capabilities and limitations—particularly with automatic circuits. Here, the valve must perform exactly as the controller dictates or the system will be thrown out of kilter.

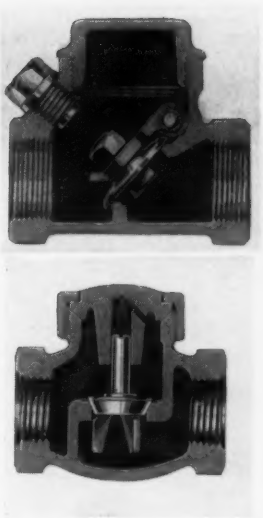
Misapplication of valves is the reason for so many ills in the improvised piping of recent years. Improper use of valves was pardonable when shortages existed, but not today when all standard sizes of many types are available. Improper application results in added plant operating costs caused by unavoidable maintenance and inefficiency.

Valve functions. Valves are used to permit or halt fluid flow. It's agreed that gate valves do the best job for simple shutoff. They have the lowest pressure drop characteristics. The outside stem and yoke is preferred, if space permits, because it exposes the operating thread and gives a good indication of position. However, the stationary spindle type may be chosen either because of lower initial cost or lack of space. Wedge gates appear to give better service in practically all operating conditions. But, the double-disk type gets some preference for very-low-pressure service because it compensates for seat distortion caused by pipeline stresses and it's easier to repair.

The cock is a popular shutoff valve where liquids carry solids, precipitates or pulp that could lodge under a gate-valve seat and foul operation. Another advantage is its quick operation, though it's harder to open and close. But don't use cock or gate valves for throttling.







These are the basic valve designs

GATE VALVE, for stop and go only, has least flow resistance; is double seated

GLOBE VALVE throttles from trickle to full flowing stream; has single seat

CHECK VALVES allow one-way flow; lift type not normally used in vertical piping

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Globe valves do the regulating and throttling jobs. Hand-operated valves fill the bill unless the setting has to be changed often. Constant setting change to maintain a uniform temperature or pressure calls for automatically-operated units. Disadvantage of globe valves: A higher pressure drop than through gate valves.

Check valves are the answer to requirements that won't permit back-up or reversal of flow. Swing checks, in either vertical or horizontal pipe runs, are usually preferred because of straight flow characteristics, low pressure drop and freedom from sticking. However, as velocities rise, a change should be made to the lift-disk. Lift checks are normally used in horizontal lines only, usually in conjunction with globe valves.

Summary. Halting flow through a pipe is a job for gate, quick-opening and plug valves. Throttling or controlling quantity of flow calls for globe, angle, needle, "Y", diaphragm, butterfly and blast valves. Controlling direction of flow is function of swing, lift, ball-check and nonreturn valves.

How to select valves. First, decide whether the medium can be handled with common valve materials or if some other alloy is necessary. Next, determine if the medium will corrode the body or trim. Common metals that are slightly attacked by a medium may be used in body and bonnet if proper trim is used. *Example:* A cast-iron brass-trimmed valve is ideal for water service even though cast iron rusts in contact with water.

Some common industrial process fluids attack brass, but not iron. So use an all-iron valve. Except in rare cases, the brass or copper-alloy trim of a brass valve has much the same corrosion resistance as the brass itself.

Several trims are commonly used on steel valves. Selection depends partly on corrosion factor but more often on temperature.

In other cases, safety dictates use of steel instead of brass because the medium is flammable or poisonous.

Temperature effects. Principal effect of temperature is loss of strength. Cast iron can generally be used up to 450 F. Higher temperatures require use of steel and, above 775 F, carbon moly, chrome moly and similar alloys are used. Screwed or flanged end connections are generally satisfactory up to 775 F. Above that, use valves with welding ends.

Corrosive-action increases in proportion to increase in fluid temperature. This is an important, though less frequent, consideration. A fluid which may be handled at ordinary temperatures by a certain metal will, in some cases, actively corrode the metal when the fluid is at or near its boiling temperature.

Low temperatures must be considered, too. Below freezing, many metals become brittle. In these circumstances an alloy, frequently a nickel-steel, must be used.

Pressure effects. Pressure determines whether a standard class or special design of valve meets the need. The American Standards Association pressure ratings and classifications (most valve manufacturers base catalog listings on these) give both primary and secondary ratings. The difference is mainly one of temperature. For instance, primary rating of brass or iron valves is for steam, secondary rating for oil, gas and water services.

Size and capacity. Valve size must agree with pipeline size. However, in designing the piping, total pressure loss through all valves may be a factor and must be considered. Size influences valve material to the extent that brass is generally used for sizes up to and including 2 in. Iron or steel is used for larger sizes. The consideration is normally one of economy. It usually costs less to build a good valve of all brass in the smaller sizes, and of iron with brass trim above 2 in. However, other considerations such as corrosion, appearance, user's preference, etc, will vary the size at which the change is made from one metal to another.

For central heating, with long piping runs to scattered buildings,

Use versatile, economical h-t water

► SIMPLICITY and lower maintenance of h-t water systems as compared with steam was our theme in January, pp 75-78. In February, pp 77-79, we discussed design of h-t water systems. This month, we're wrapping up the package with performance of h-t water systems now in service.

One such system is used by a prominent manufacturer of abrasive products who acquired a group of buildings, photo p 101, formerly set up as an assembly plant. Two shed-like structures (each 1500 x 150 ft) had 10-psi steam heating systems. Other buildings had underground-duct hot-air systems.

First step was to take out the uneconomical hot-air setup and install a modern h-t water system. Since necessity dictated keeping the two steam systems, these were tied into the h-t water system through a steam producer. All three were supplied by two new 200-psi boilers having h-t water outlets and returns connected to the drums.

Total heating load was calculated to be about 32-million Btu per hr to supply an 1130-ft long sandpaper dryer (required air temperatures 200 to 300 F) plus unit heaters for space heating. Calculations included a planned second dryer (each dryer taking 1-million Btu per hr) and other heat using equipment needed for future plant expansion.

Three circulating pumps—one each for process and space heating and the third for standby—handle the job. The space-heating main extends about 2000 ft from the boilers, then splits into three sections. Two sections provide h-t water space heating; the other supplies the steam producer and a plant process-water heater.

Speedy heat transfer is a measure of system's efficiency. In less than a minute after circulating pumps are started, there's equal heat distribution—even at points 3000 ft from the boilers.

Another h-t water installation that pays real dividends is in a Southern hospital training school. Here, a large number of widely scattered buildings, photo, above, take supply from boilers over a mile away. The fact that (1) long piping runs could follow the ground's contour and (2) no traps were needed made the initial cost much lower than for a steam system with its attendant piping-pitch and return-condensate problems.

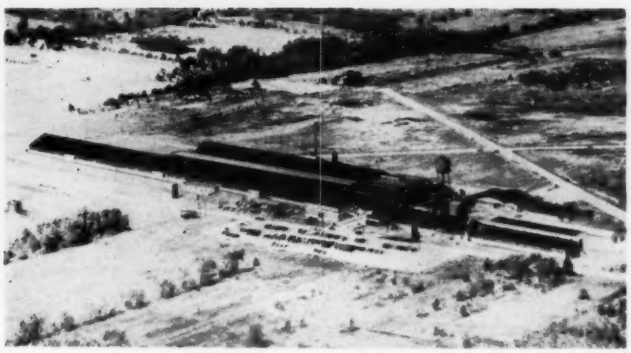
System components were covered in the previous articles, so there's no point in listing equipment used at this location. While tailored to meet the school's needs, this system doesn't differ from any other modern h-t water installation. Interesting feature, of course, is the system's heat-distribution efficiency and low maintenance requirements despite the distances involved.

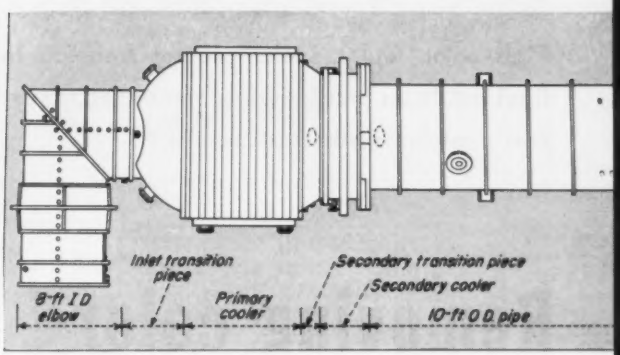
A new twist concerning application of h-t water is the Navy's setup at its Air Turbine Test Station near Trenton, N. J. Here, h-t water handles a tough *cooling* job.

The Navy wanted to eliminate all guesswork by ground-testing jet engines at pressures and temperatures simulating 65,000-ft altitude. But testing jets and prototype jets on the ground under very low temperature-pressure conditions is a king-size project. Aircraft jet-engine speeds and temperatures run high; turbines turn over at more than 10,000 rpm and tailpipe exhaust temperatures climb above 1000 F.

Test stand setup meant hot exhaust gases would have to be brought from the tailpipe through a jacketed pipe to an exhaust cooler. Designing a cooler to tame the raging exhaust wasn't easy because the unit would have to handle

By P L GEIRINGER, *Chief Engineer* and B M VENABLE, *Project Engineer*
American Hydrotherm Corporation





for factory process, space heating, or jet engine cooling

a heat transfer load of some 300-million Btu per hr. Under maximum operating conditions exhaust gas at 1200 F and 14.2 psia would have to be cooled to 175. In addition, the cooler would be subjected to startup temperatures as low as –70 F and a minimum gas pressure of less than 1 psia.

The cooler evolved as a two-stage unit, using h-t water as the cooling medium. H-t water circulates through the primary cooler (watertube box-header design) tube banks, drawing, above, in a completely closed circuit with a water temperature rise from 130 to 370 F. About 270-million Btu per hr is absorbed in this circuit. This heat transfers to the second stage—a cooling-tower circuit — through an indirect shell-and-tube heat exchanger.

H-t water supplies the heat necessary for low-temperature startup. Keeping the h-t water pressurized in a closed circuit prevents any loss of water by flashing. Temperature of the water leaving the second stage heat exchanger doesn't rise above that normal to conventional cooling-tower circuits.

A secondary cooler, also in the cooling-tower circuit, absorbs remaining heat load to bring exhaust gases to the lowest possible exit temperature.

Use of h-t water as the primary coolant permitted smaller pump and pipe sizes than would be possible with a conventional water-cooling system. It also resulted in the usual h-t water system advantages of lower initial cost and smaller operating costs.

Snow melting is another job that h-t water can do economically. Removing snow and ice from public and private thoroughfares by circulating a heating medium through buried piping has always appealed to property owners. But until recently, technology for installing a foolproof functioning system on a large scale wasn't available.

Early attempts at snow melting didn't enjoy much success. First method used steam pipes embedded in the ground. Large sections promptly collected condensate and froze.

Low-temperature water, 100 to 200 F, was tried next. Operating at about 150 F with a 10 to 20 F temperature drop and with antifreezes or light-oil mixtures added, these were fairly successful for sidewalks, ramps, etc, but installation costs ran rather high. Depending on size and location, they cost from $2 to $4 per sq ft (for areas larger than 1000 sq ft) including all equipment except boilers and other heat producers.

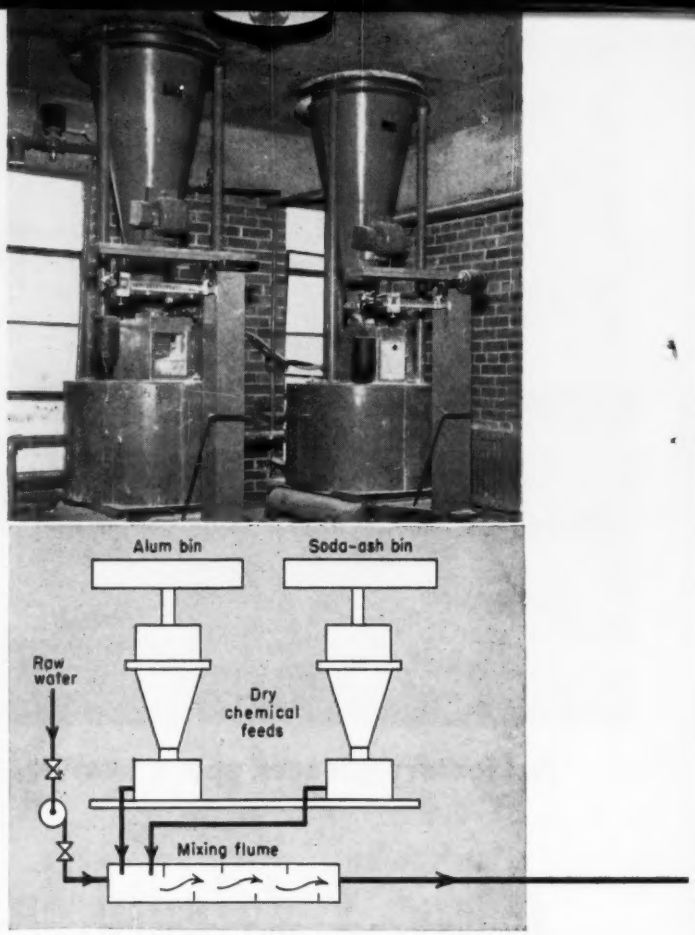
But large areas—airport aprons, runways, etc—posed problems figuratively as big as the areas. Pumping the amount of water needed to heat a 1-million sq ft area takes some doing. Biggest headache is the water's tendency to cool before reaching its destination. Attempts to overcome this by using high-velocity flow from high-capacity boilers run into almost insurmountable technical difficulties.

New methods using h-t water at temperatures up to 350 F have been tested with continuing success since 1947. Experience shows that 100 to 250 Btu per sq ft is needed to keep concrete at an even heat to avoid snow accumulation. The heat dissipated goes into the earth and water, tends to help melt the subsequent falling snow.

With h-t water, piping spacing can be on 4- to 6-ft centers. This means big savings in amount and size of piping plus advantages of using smaller pumps. Systems in use are proving this different concept of heat transfer to such a degree that many engineers foresee a new era in the field of wet heat.

High-color water spells process trouble. In final article on process-water treatment, an expert explains method of . . .

Removing color from industrial process water



CHEMICAL FEEDERS (dry type shown) add coagulants and chemicals to raw water. From mixing flume, water passes to . . .

By **ESKEL NORDELL**
Director of technical information, The Permutit Company

► HIGH-COLOR WATER means trouble for the process industries. Color picked up during processing produces stains, streaks, tints and off-colors in such products as pulp, paper, textiles, plastics and many other materials. Though the damage is usually apparent, the solution is not always direct or simple.

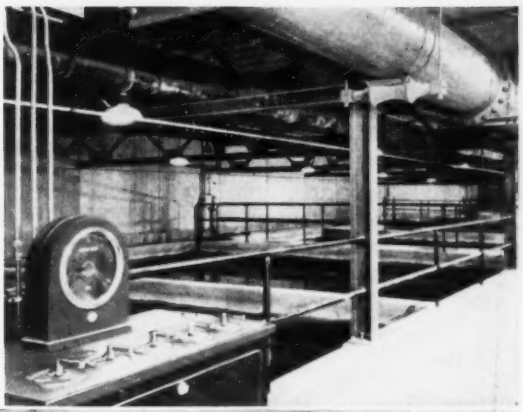
What is high-color water? Any water that at any period has a color exceeding 20 ppm (parts per million) is definitely in that class. Many industries have their limits set lower than this, while others may be able to tolerate higher color. Drinking-water tolerances are set at 20 ppm, but even that is too high for many processes. The Technical Association of the Pulp and Paper Industry, for instance, suggests tolerances of 5 ppm for high-grade products and only 15 ppm for lower grades. This range also applies to textiles. In the food industries—baking, brewing and food processing—tolerances run from 5 to 10 ppm. Limits for boiler feedwater, recommended by the New England Water Works Association, vary from a high of 80 ppm at pressures of 0 to 150 psi to a low of 2 ppm for pressures over 400 psi.

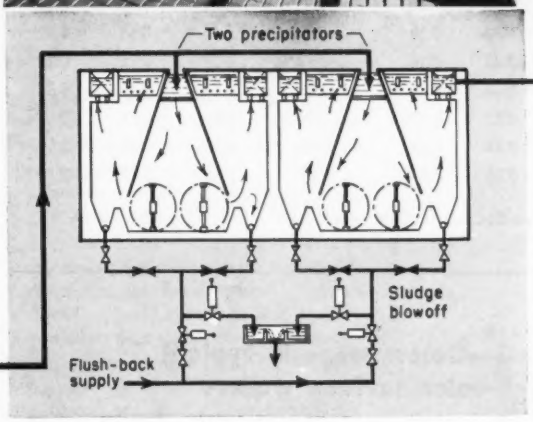
How do we measure color? Surface waters originating in swampy areas are responsible for most of the high-color waters. This color, a complex mixture of organic materials extracted from decaying vegetation, varies over a fairly wide range during the year, Table 2, p 104. It differs in composition in different waters and also, at various times, in the same supply. This makes it impractical to try to determine actual amounts of coloring material. Instead, we measure depth of color by visual comparison with American Public Health Association color standards. The primary standard contains 500 ppm platinum and 250 ppm cobalt and is stated to have a color of 500 ppm. Other standards are made by diluting this primary standard. Extremely dark colors are diluted to bring them within the range of the color standards.

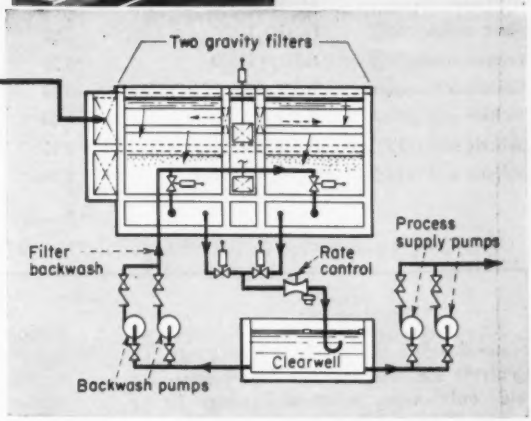
In addition to the various color substances, most of which are colloidal in nature, high-color waters often contain iron and manganese in an organic or "chelated" form (See POWER, April 1956, p 91, "How to remove iron and manganese from industrial process water".) This is so firmly held that it is either (1) not removed or (2) only partially removed by the usual aeration, settling and filtration processes. High-color well waters usually contain more objectionable iron and/or manganese than ground waters. As with color, the amount may vary over a wide range during the year. Fortunately, in most cases, it may be removed together with the color.

Coagulation, settling, filtration will generally remove or reduce color to specified tolerances.

Finely divided particles in water will stay suspended for a long time unless







COAGULATING UNITS where color and turbidity are picked up by floc. Bulk of floc settles out and effluent enters . . .

FILTERS that remove any slight traces of insoluble material. Water flows from filter (gravity type shown) to clearwell

they can be made to form larger heavier particles. A coagulant is a material that brings this about. Most widely used coagulant is aluminum sulfate, but ferric sulfate and chlorinated copperas are also used. Amounts to be added, best pH for coagulation and need for coagulant aids are best determined from simple jar tests in which small water samples are coagulated, settled and filtered.

High-color waters that have a low mineral content and are nearly free of turbidity are the most difficult to coagulate. Such waters tend to coagulate well only in a narrow range of rather low pH values, and the optimum pH varies with different waters. Repeated tests have shown that when turbidity was present, as after a heavy rain, coagulation of these waters was more complete and took place over a wider pH range. The floc formed was larger and heavier and therefore settled more rapidly. This led to the practice of adding a finely divided, insoluble substance, such as clay or activated silica—(prepared at the scene by treating solutions of sodium silicate with either sulfuric acid, ammonium sulfate, chlorine or carbon dioxide).

Aluminum sulfate ("filter alum") is the coagulant most widely used for color removal. It reacts with alkalinity (natural or added) of the water to form a gelatinous precipitate of basic aluminum sulfate. This has an "atmosphere" of electrical charges — mostly positive but with some negative. Since most of the colloidal coloring materials carry negative charges, the precipitate attracts them. The precipitate also physically enmeshes the organic matter.

The pH value is adjusted with soda ash or sulfuric acid. Table 1, p 104, shows effect of adding various coagulants and sulfuric acid. Neutralizing power of these chemicals for pH adjustment is also shown.

Chlorination exerts a bleaching action on some colored waters but has little or no effect on others. Amounts exceeding the break point will not increase bleaching action. Main value of chlorination in water treatment is as a killer of microorganisms.

Activated carbon has an adsorbent effect on some colors and is sometimes used for polishing treatment. But its color adsorbent capacity varies widely with different waters. So use of activated carbon is reserved largely for taste and odor removal.

Color-removal equipment usually consists of chemical feeders, coagulating and settling units, and filters (see flowsheet, above).

Chemical feeders may be divided into two classes—wet and dry. Dry feeders shown on flowsheet handle dry chemicals. Wet feeders handle soluble chemicals in solution and insoluble or slightly soluble chemicals in suspension. Both types are further classified as constant rate or proportionating. When

Table 1: Coagulation and pH adjustment

Coagulants and sulfuric acid		Effect per ppm added				Alkali and lime to neutralize 1 ppm			
Name	Formula	Alkalinity decrease as ppm $CaCO_3$	Sulfate increase as ppm $CaCO_3$	ppm CO_2 formed from bicarbonates	ppm CO_2 formed from carbonates	Soda ash 58% Na_2O	Caustic soda 76% Na_2O	Hydrated lime 93% Ca(OH)$_2$	Chemical lime 90% CaO
Aluminum sulfate	$Al_2(SO_4)_3 \cdot 18H_2O$	0.45	0.45	0.40	0.20	0.47	0.37	0.36	0.28
Ferric sulfate (90%)	$Fe_2(SO_4)_3$	0.68	0.68	0.60	0.30	0.72	0.55	0.54	0.42
Ferrous sulfate	$FeSO_4 \cdot 7H_2O$	0.36	0.36	0.32	0.16	0.38	0.29	0.28	0.22
Chlorinated copperas	$FeSO_4 \cdot 7H_2O(+ \frac{1}{2}Cl_2)$	0.54	0.36*	0.48	0.24	0.58	0.44	0.43	0.34
Sulfuric acid (98%)	H_2SO_4	1.00	1.00	0.88	0.44	1.06	0.81	0.79	0.62
Sulfuric acid (93.2%)	H_2SO_4 (66° Be)	0.95	0.95	0.84	0.42	1.02	0.78	0.76	0.59
Sulfuric acid (77.7%)	H_2SO_4 (60° Be)	0.79	0.79	0.70	0.35	0.85	0.65	0.63	0.49

*Chloride increases as $CaCO_3$ = 0.18 ppm

water flow is fairly steady, constant rate controls are used and the feeder operates only when water is flowing. If water flow is variable, proportionating controls are used to feed chemical in proportion to the water flow rate. Chlorinators are also available for constant or variable flows.

Coagulation and settling equipment must do two things: (1) Allow enough detention time for complete coagulation with formation of a large tough floc (2) Settle out the bulk of the floc to ease filter load and permit longer runs between backwashings. Settling tanks or basins represent older types of equipment for this, while floc-forming and precipitating units represent later developments. Settling tanks, usually made of steel, were most often installed on a concrete slab above ground level. Basins were commonly made of concrete and were generally below ground level.

Floc-forming is a later technique. Raw water, on entering the first chamber of the floc-former, is mixed with chemicals. The treated water flows successively through floc-former chambers, each of which is fitted with agitators. Agitator speed is controlled to give a gently rolling mix. The coagulated water then flows to a baffled settling basin. Here the bulk of the floc, plus all the color and turbidity it has picked up, settles to the bottom and is discharged through a sludge-removal system. Filters perform final clarification.

Latest development is the "sludge blanket" or "suspended solids contact" unit such as the precipitator shown in the flowsheet. Raw water enters the mixing flume where chemicals are added to the water. A large tough floc is produced as the mixture passes down through the central mixing zone. The water then rises and is settled and filtered through previously formed sludge in the outer section. Increasing cross-sectional area of this outer section results in decreasing vertical velocity of the rising water. Thus, water reaches a point where its velocity is so low that it leaves the sludge behind. In practice there is a clean line of demarcation between sludge and water.

Maximum adsorptive and straining effects are obtained because of the intimate contact of water with precipitates. Detention time is only 60 or 70 minutes compared to four or six hours in settling tanks and basins. This represents a considerable saving in ground space for equipment. If a very high degree of color removal is required, filters follow coagulation and settling units.

Filters will remove any slight traces of insoluble material not removed in the previous stages. Sand is the most widely used filter medium. There are two types—pressure and gravity. In the pressure type, the filter media is contained in a closed steel shell, while in the gravity type, an open concrete shell (occasionally wooden or steel) is used.

Table 2—Color range in typical high-color surface waters

Name and Location	Color in ppm	
	High	*Low*
Charles River, Shannock, R. I.	100	50
Cuyahoga River, Cleveland, Ohio	160	15
Edisto River, Charleston, S. C.	300	60
James River, Buchanan, Va.	200	15
Prudhomme Lake, Watson Island, B. C., Can.	105	45
Rainy River, International Falls, Wis.	80	40
Rappahannock River, Fredericksburg, Va.	60	4
South Anna River, Vantay, Ga.	70	15

Pressure filters are of two main types —vertical and horizontal. Industrial size vertical units run from 30-in. diameter with a flow of 15 gpm up to 120-in. diameter with a flow of 235 gpm. Horizontal filters generally have a flow range of 200 to 516 gpm.

During filtration, water under pressure enters the upper part of the filter, slowly passes down from layer to layer of graded filtering material to an underdrain system from which it flows to service. Filtration is performed on the surface and upper layers of fine filter sand. As coagulated material collects in the filter, a pressure differential builds up. When it reaches a predetermined level—usually 5 to 7 psi—the filter unit is backwashed. This takes about 10 minutes and requires settled or filtered water.

Concrete gravity filters (see flowsheet) usually discharge to a clearwell, from which water is pumped to service. This clearwell also serves to supply filtered water for backwashing. Operation and operating results are similar to pressure filters. Backwashing, however, is done after buildup of a much lower pressure differential. Gravity filters are usually found on large jobs.

Operating results. Coagulating units of the type shown in the flowsheet have only one hour detention, yet waters with turbidities as high as 2500 ppm yield effluents with only 5 to 10 ppm turbidity. Similar units treating high-color waters with low turbidity have reduced colors of 400 ppm to the 10 ppm level.

Plant records of color removal at pulp and paper mills show effectiveness of upflow coagulation. Plant 1 has obtained excellent results in treating a high-color, low-turbidity water. Note that color content and turbidity have been greatly reduced by coagulation prior to filtration.

Plant 2 made a 3-year study of their water containing high to very high color with fairly constant turbidity (Tabulated averages are taken from many readings, not just those shown).

Plant 3 shows hourly changes from plant's daily water log of pH, color and turbidity. Effluent color and turbidity are quite constant compared to variations in the raw water.

Upflow coagulation often does away with the need for filters. But certain processes do require them. In the plants cited, coagulation ideally prepares water for filtration. Any slight turbidity remaining in the coagulator effluent is readily filterable, giving 60- to 70-hour filter runs.

PLANT RECORDS OF COLOR REMOVAL

Plant 1—High-color water

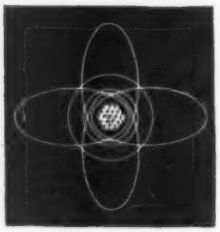
	Raw water	Precipitator effluent	Filter effluent
Color	90 ppm	15 ppm	1 ppm
Turbidity	7	2	0-1
Iron	0.22	0.01	Trace
Color	100 ppm	15 ppm	1 ppm
Turbidity	2	2	0-1
Iron	0.2	0.01	Trace
Color	105 ppm	17 ppm	1 ppm
Turbidity	2	2	0-1
Iron	0.2	0.01	Trace

Plant 2—Color and turbidity changes over 3-yr period

	Raw		Finished	
Date	Color	Turbidity	Color	Turbidity
3-13-51	175 ppm	3.1 ppm	12 ppm	3.1 ppm
2-5-52	160	1.4	8	5.5
6-3-52	150	15.0	12	8.0
6-17-52	80	8.0	5	3.0
8-19-52	275	12.0	12	10.0
10-9-52	140	20.0	3	4.0
2-5-53	160	1.4	8	5.5
8-26-53	225	10.0	12	1.4
12-18-53	120	8.0	8	13.1
Average	150	11	8.5	5.0
Minimum	80	1.4	3	1.4
Maximum	275	20	12	13.1

Plant 3—Daily water log on highly colored water

	Raw			Finished		
Time	pH	Color	Turbidity	pH	Color	Turbidity
8	5.3	100	13	5.2	10	3
10	5.5	85	14	5.4	10	3
12 Noon	5.3	85	14	5.3	15	4
2	5.1	120	24	5.2	15	4
4	5.1	120	160	5.1	15	4
6	4.9	120	157	4.9	10	3
8	4.9	140	160	4.9	10	3
10	4.9	120	115	4.9	10	3
12 Mid	5.1	110	15	5.1	10	3
2	5.1	100	14	4.9	10	2
4	5.1	100	14	5.0	10	2
6	5.3	100	14	5.1	10	2



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

First reactor completed in AEC's power reactor program, Experimental Boiling Water Reactor (EBWR) at Argonne National Laboratory, Lemont, Ill., went on the line on February 9th. Its 20-mw heat produces 5-mw electric power for use in the labs. Steam at 600 psig, generated directly in the reactor core, drives the steam turbine. Data from Borax I, II and III yielded the design information for EBWR. The reactor uses natural uranium enriched to 1.4% with U-235 to run with natural water. Heavy-water operation will be tried in the future, showing potentiality for using unenriched natural uranium.

AEC has issued Standards For Protection Against Radiation, effective Feb 28, 1957. The regulation sets up standards for handling all radioactive materials subject to AEC licensing—special nuclear materials such as U-233, U-235, source materials such as natural U and thorium, and radioisotopes. The standard prescribes limits for exposure of workers to external radiation, concentrations of radioactive material that may be discharged into air and water, and disposal of radioactive wastes. Regulations also include need for surveys of radiation hazards by licensees, monitoring of workers, caution signs, labels, signals, storage of licensed material and instruction of workers on safe procedures in handling licensed materials.

Solution-type reactor shuts itself down under abnormal operation, says Atomics International, after testing 50-kw Kinetic Experiment for Water Boiler Reactors (KEWB). This reactor carries nuclear fuel in a water solution. Gas bubbles in the reactor fuel, formed by rising temperature, stop the chain reaction. This reactor type offers advantages in medical, industrial and research fields.

Merchant-ship reactors will be jointly developed in a long-range program by AEC and Maritime Administration. Major aim will be to develop commercially competitive power for merchantmen. Six private contractors will work on reactor studies: (1) Atomics International — organic-moderated and cooled reactor (2) Ford Instrument Co—closed-cycle gas turbine with gas-cooled reactor (3) General Atomic Div of General Dynamics Corp—closed-cycle gas turbine with hydride-moderated helium-cooled reactor (4) AMF Atomics, Inc—boiling-water reactor (5) General Motors Corp —closed-cycle gas turbine with graphite-moderated helium-cooled reactor (6) Babcock & Wilcox Co—advanced type pressurized-water reactor.

What's holding up nuclear power? Atomic Industrial Forum, Inc polled 427 member organizations to get their opinion of what factors are delaying the development of nuclear energy. Primary factors according to 167 who replied were: Lack of economic incentive, lack of insurance and indemnification protection, secrecy and classification of technical information by government, lack of trained manpower, government administrative policies and practices.

Government indemnification to supplement private insurance has been recommended to give protection to the public and industry against atomic accidents. This was made by the Legislative Drafting Research Fund of Columbia University for the Atomic Industrial Forum. The indemnity program should cover government contractors as well as licensees with no limit on amount of indemnity.

Late spring will see more testing of low-yield nuclear weapons by AEC, Department of Defense at the Nevada Test Site. Series will be dubbed "Operation Plumbob."

Power's DATA SHEET

No. 297

Comparative costs of power transformers

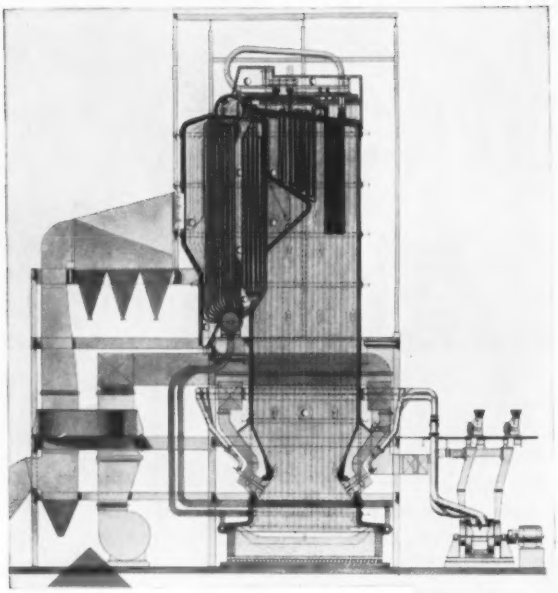
	High-voltage rating, kv				
Kva	13.8	23	34	46	69
Without load tap changing					
750	$6,500	$8,000	$9,000	$9,500	$11,500
1,000	8,000	9,000	10,000	10,500	13,000
1,500	10,000	11,500	12,500	13,000	16,000
2,500	14,500	15,500	16,500	17,500	21,000
3,750	19,000	20,000	20,500	22,000	26,000
5,000	23,500	24,500	25,000	27,000	30,500
7,500	31,000	32,500	33,000	35,000	40,000
10,000	39,000	40,500	41,500	43,500	48,500
15,000	55,000	57,000	58,500	60,500	66,500
20,000	71,000	73,500	76,000	77,000	85,000
With load tap changing					
750	$13,000	$15,500	$16,500	$17,000	$19,500
1,000	14,500	17,000	18,000	18,500	21,000
1,500	18,000	20,000	21,000	22,000	25,000
2,500	24,000	25,000	26,000	27,500	31,000
3,750	29,500	30,500	31,000	33,000	37,000
5,000	35,000	36,000	36,500	39,000	42,500
7,500	46,000	47,000	47,500	50,000	54,500
10,000	56,500	57,500	59,000	61,000	66,000
15,000	77,000	79,000	80,500	82,500	89,000
20,000	107,500	110,000	113,000	114,000	122,000

► THESE COSTS apply to outdoor oil-insulated 3-phase 60-cycle transformers with low voltage of 2400, 4160 or 13,800 volts, with high- and low-voltage bushings, and necessary insulating oil.

Use these costs for comparison only. For system estimates add costs for engineering, drafting, overhead, contingencies and local conditions. These may add from 20 to 60% more over the basic equipment cost. For accurate current prices contact manufacturers, consulting engineers or contractors.

From Electric Power Distribution for Industrial Plants, AIEE No. 952

© POWER



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We mean by "Fuel Insurance" simply that the Riley TURBO FURNACE is designed to burn the "worst" fuel that can be anticipated. Low volatile *Fluid Coke**, for example, is burned with ease in the TURBO FURNACE; high ash, low fusion temperature *coals* are efficiently burned . . . and without slagging difficulties. Complete combustion of a high moisture fuel

Delaware Power and Light Co. will burn the Fluid Coke from the new Tidewater Oil Flying "A" Refinery in three 500,000 lbs/hr Riley TURBO FURNACE Units. Refinery Gas, Oil, Coal will be standby fuels. C. F. Braun & Co., Engineers and Contractors

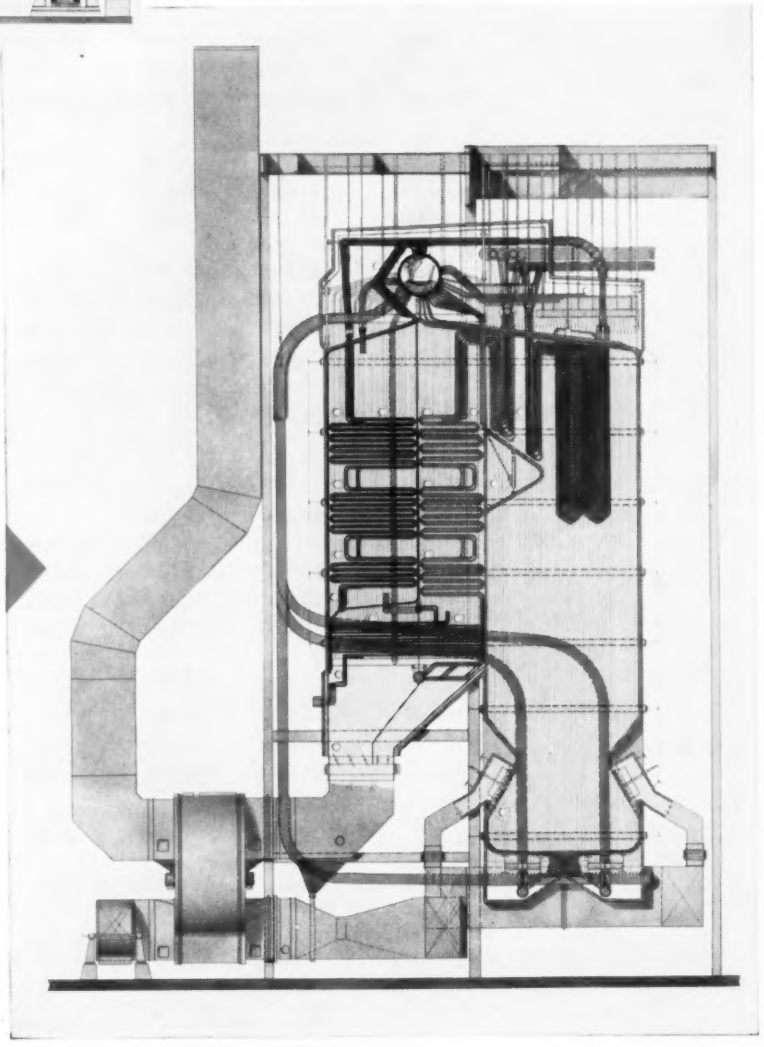
* *Fluid Coke*, is an extremely hard almost pure carbon by-product of the most recent development in catalytic cracking *to burn effectively*. It needs a furnace that provides high heat concentration after being reduced to required fineness by special Riley Pulverizers.

★ ★ ★

Louisiana Power and Light Co. will burn natural gas in its 1,550,000 lbs/hr Riley Reheat TURBO FURNACE Unit—it can quickly utilize oil, coal, lignite, refinery coke when economically justified.
Ebasco Services, Inc., Engineers

★ ★ ★

The TURBO FURNACE is enjoying rapid acceptance. It was formally introduced in the Fall of 1955 following extensive operation of actual installations that thoroughly established Riley's claims for its performance and design. Since then, thirteen TURBO FURNACE units have been sold to public utilities and large industrial companies. The total steaming capacity of these thirteen boilers exceeds 8,000,000 lbs/hr.



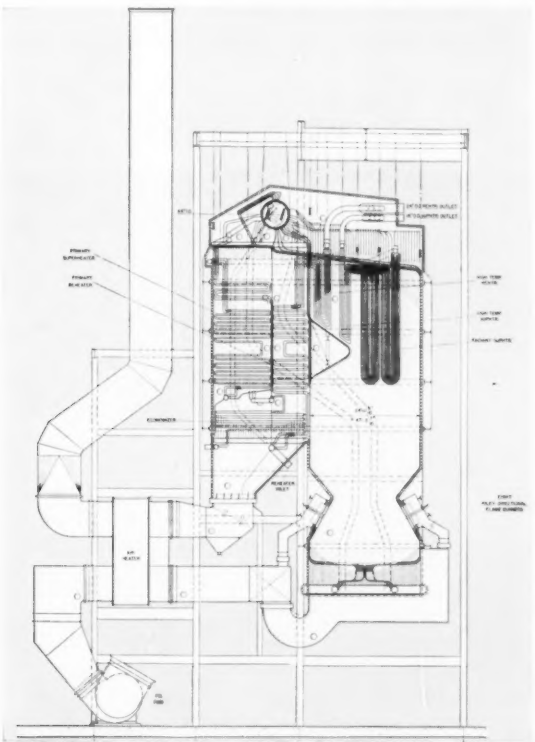
RILEY DESIGNS, MANUFACTURES AND INSTALLS COMPLETE STEAM GENERATING UNITS AND FUEL BURNING EQUIPMENT FOR PUBLIC UTILITY AND INDUSTRIAL POWER PLANTS

FUEL INSURANCE with the TURBO FURNACE

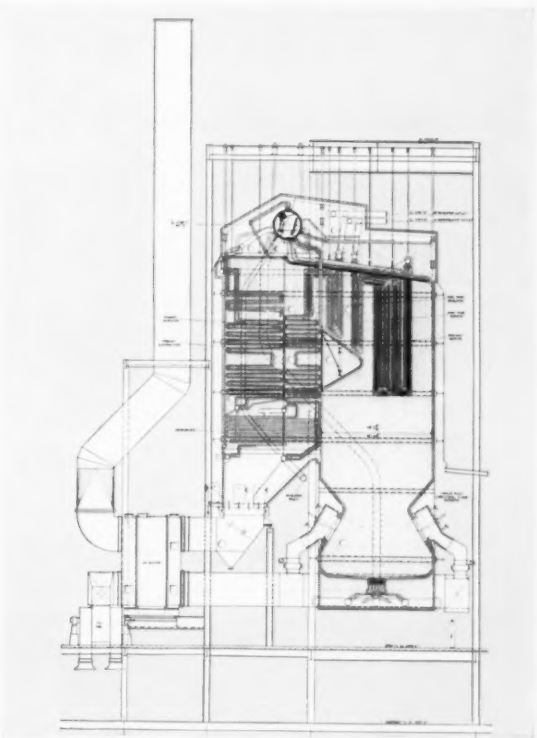
such as *lignite* is accomplished in the high temperature and turbulence of the combustion zone; the TURBO FURNACE not only utilizes *gas* and *oil* efficiently, but offers the quickest and least costly means by which to convert from *gas or oil* to solid fuels.

There is no premium for TURBO FURNACE "Fuel Insurance" . . . it is competitively priced.

Its "extra dividends" include clean furnace walls without the use of wall deslaggers, negligible combustible losses, elimination of the problem of fly ash disposal, lower overall height of unit, one level burner operation and the elimination of burner refractory and its maintenance. Write for complete details to Riley Stoker Corporation, Worcester, Mass.



Dallas Power & Light Company will burn natural gas and oil. Texas Lignite in the future in this 1,250,000 lbs/hr Reheat Unit. Ebasco Services, Inc., Engineers.



Texas Electric Service Co. will burn natural gas and oil in this 825,000 lbs/hr Reheat Unit. It can quickly convert to pulverized coal. Ebasco Services, Inc., Engineers.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

NORDBERG

"standby" Diesel increases steam plant efficiency . . . cuts operating costs

HERE in Woodstock, Illinois, residential customers and industry alike depend solely on the municipal plant for power. "*It's a big responsibility,*" states William H. Day, City Manager at Woodstock, "*and the principal reason why this city recently diversified its power generating equipment.*" Now on the line, in a plant previously powered by three steam turbines, is a 3660 hp, 2610 kw Nordberg *Supairthermal*® Duafuel engine. Its addition increased plant capacity to 16,610 kw . . . more than double peak demand.

The Nordberg engine was purchased as a standby unit to quickly supply the total residential power needs in case of boiler or turbine failure and to handle peak load conditions. The new *Supairthermal* engine has fulfilled all these needs and more . . . it has demonstrated its dependability and economy to such an extent that it has become a base load unit during the summer months. It generates about 10 per cent of the monthly production of over three million kwh, and is helping to lower costs of the entire power plant operation.

Woodstock's experience is added proof of the ability of Nordberg engines to provide reliable, low cost power for municipal and industrial service. Write for information on Nordberg engines to meet your specific power requirements . . . in sizes to over 12,000 hp.

NORDBERG MANUFACTURING COMPANY, Milwaukee, Wisconsin

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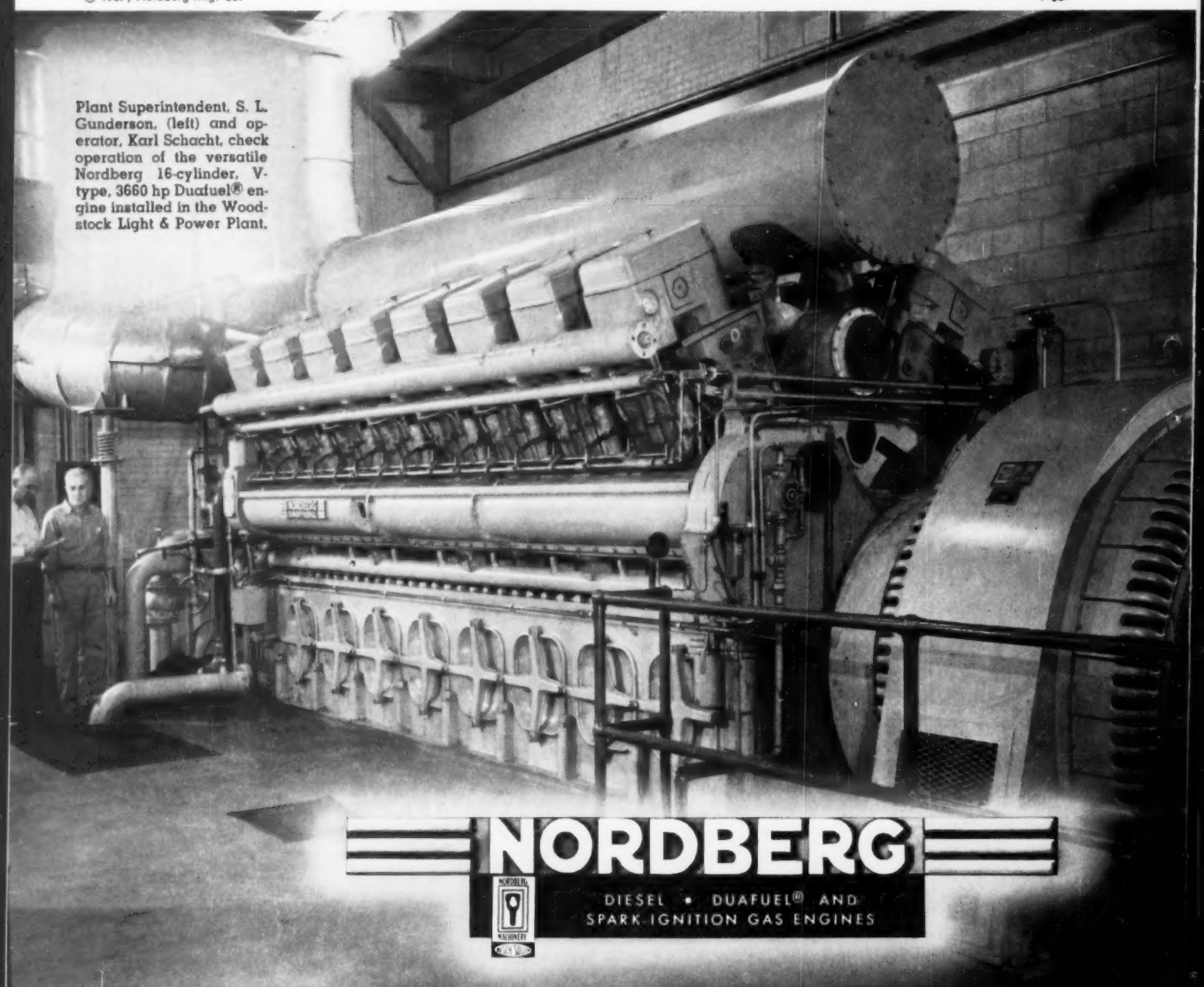
P-357

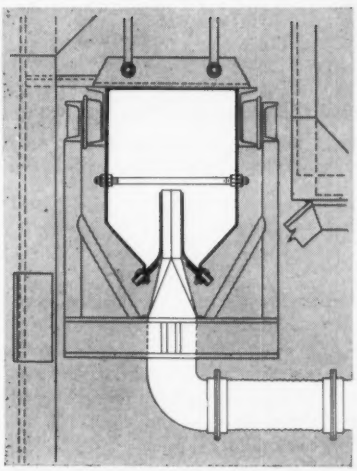


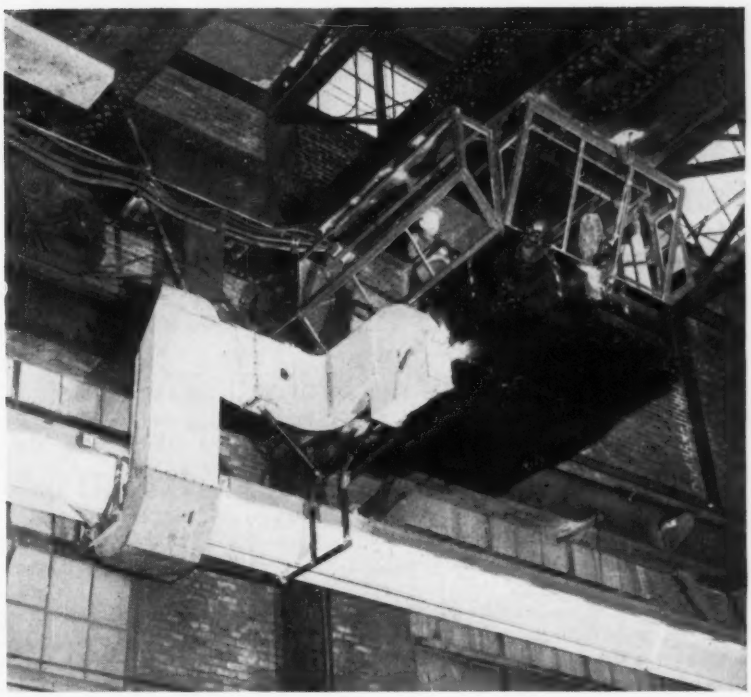
Plant Superintendent, S. L. Gunderson, (left) and operator, Karl Schacht, check operation of the versatile Nordberg 16-cylinder, V-type, 3660 hp Duafuel® engine installed in the Woodstock Light & Power Plant.

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

STEVE ELONKA
Associate Editor in Charge





"ZIPPER VENTILATOR" brings fresh air to cab regardless of crane's position in building. Drawing, above, shows main duct valve and cab duct nozzle. Photo, right, shows trolley-supported cab duct

Avoid easy-to-make mistakes that cramp results from . . .

Your ventilating equipment

By **ALLEN D BRANDT**
Chief Industrial Hygiene Engineer
Bethlehem Steel Company

► INDUSTRIAL PLANT ventilating equipment for controlling heat and air contamination is costly to install, operate and maintain. No engineer will dispute this. But whether or not the equipment is doing the intended job is something else. Admittedly, the ventilating system improves air conditions, but to what extent? If the desired goal hasn't been achieved, why not?

Possibly some important factors have been overlooked, or existing conditions were not understood when translating them to design specifications. These items must be considered if ventilating equipment is to be selected on a scientific and economical basis.

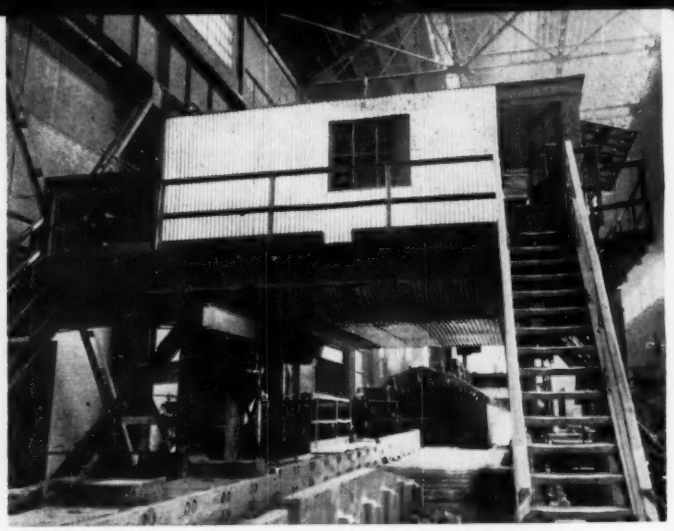
But rather than review and emphasize engineering and design principles, let's look at some typical installations that were fouled up, or would have been if the error hadn't been corrected.

Case No. 1. The spray-painting area in one wing of a large, unpartitioned building had to be expanded. Large objects to be painted — airplane fuselages, wings, etc—were positioned and spray-painted in front of propeller fans in the building wall. This gave fairly good mist control. When increased painting activities became a must, fans were installed in the opposite wall. But, because adjacent earth-moving activities presented a dust problem, all doors and windows were kept closed.

When the new fans were started, employees in the painting wing began to suffer from paint mist and vapor concentrations. When only original fans were running, the situation eased off.

Turn page

ALUMINUM PANELS protect conduit from heat radiated by coiled hot strip, right. Shielding prolongs insulation life



SHIELDING of all exposed surfaces, except window, of this rolling mill pulpit reduced radiant heat load tremendously

Investigation showed that the new fans were of higher capacity and speed than those in the opposite wall. The new fans reversed direction of air flow through the old ones, created a negative pressure in the spraying wing. *Result:* Gross contamination of the air caused by the painting along the original wall.

A bank of air filters installed in the wall most remote from the outside dust source solved the problem. This also points up a basic consideration that engineers often overlook: *Air can't be removed from a space faster than it enters.* You can't count on infiltration around doors and windows to provide the makeup air required by an exhaust system. If you do, it's likely that your system is air-starved.

Case No. 2 involved a plant using 53,000 cfm of blast-furnace gas as fuel for big engines. A number of minor gas leaks produced fairly high CO concentration throughout the building. Amount of gas escaping was small, but with a 30% CO content (threshold limit for CO is 100 ppm) the condition was intolerable.

When attempts at local exhaust ventilation proved unsuccessful, the plant called in a consultant. Plant engineers and the consultant decided to put fans in six sections of the high-low bay roof. Windows that could be opened formed the vertical portions of the roof structure.

Fans were to be 60,000 cfm capacity each, giving a total proposed ventilation rate of 360,000 cfm. But before buying them, plant engineers were smart enough to analyze all aspects of the problem to determine if roof fans were the best solution.

It's a good thing they did, because the analysis revealed some startling facts. First, a casual study showed that natural ventilation rate through the building with the roof windows "as found" was about 420,000 cfm—15% above the proposed roof fans. Obviously, the fans wouldn't be an improvement on days when climatic conditions were similar or more favorable.

Second, roof fans would improve conditions for the bridge crane operator on days when natural ventilation was low, but the fans wouldn't control his exposure because it was already too high on days with good natural ventilation.

Another objection: Men on the operating floor wouldn't get much benefit from roof ventilation. Most of the makeup air would enter through windows in the building's long walls and flow toward the roof, thus short-circuiting most of the floor area.

This example teaches two important lessons. (1) Ventilation rate must be high enough to dilute contaminated air to a hygienic level. And it follows that general ventilation usually isn't the answer to control of a major source of air contamination because of the required high-ventilation rate. (2) Airflow direction must produce a relatively clean air pass through the exposed employees' breathing zones.

Now, let's see how the problem was solved.

Second requirement for general ventilation (above), which would have made it tough to solve this problem by means of an exhaust ventilation system, pointed the way to success. A partitioned basement could be adapted to serve as a plenum for supply ventilation if the floor had grilles installed in the right places. So in went the grilles, together with two centrifugal blowers having a total capacity of 350,000 cfm at 2 in. water-gage static pressure. Supply air, going through part of the basement and up through the floor, picked up the leaking gas and carried it toward the roof.

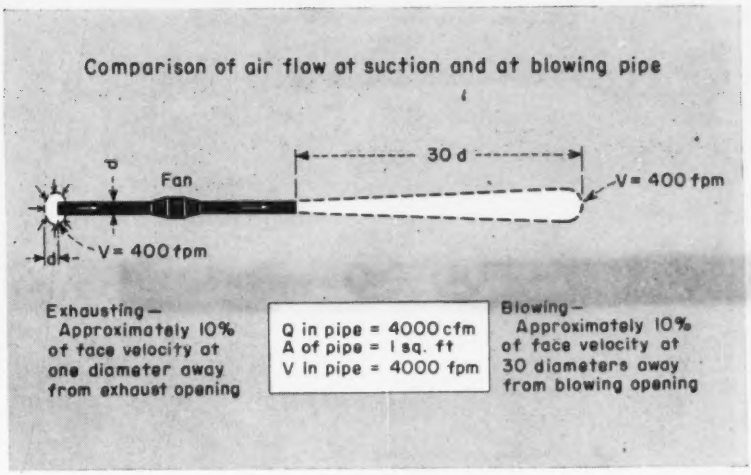
This put the men on the operating floor on the clean-air side of flow direction, but put the overhead crane operator in a rough spot—directly in the contaminated air as it swept toward the roof and escape.

Unique arrangement, drawing and photo, p 111, was the answer to this problem. Uncontaminated outside air, blown into a duct located at cab level and running the length of the building, supplied fresh air to the crane cab regardless of the crane's position. The drawing shows duct's shape; photo shows its location with respect to the crane cab.

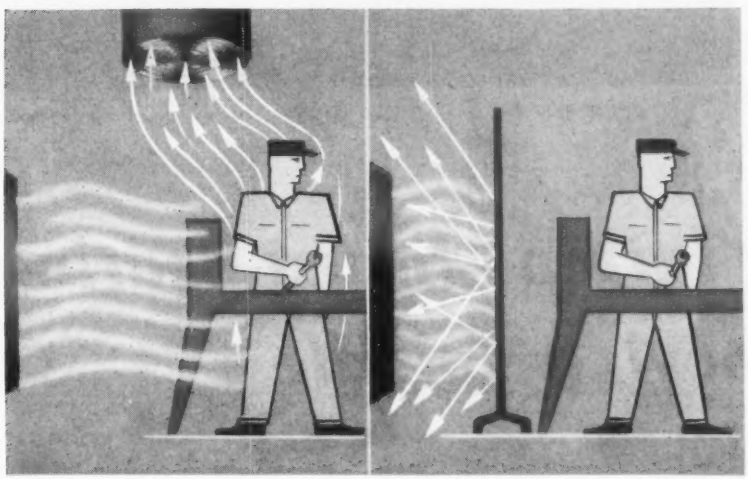
Rubber belting forms the lower part of the supply duct and serves as a valve that stays closed at all times by virtue of its construction, plus the 0.4-in. water-gage static pressure in the duct. A second duct, photo, p 111, attached to the cab and supported by a carriage on the main duct, brings air to the crane cab.

A streamlined nozzle at the end of the cab duct extends through the rubber valve, drawing, p 111, and slides along in the main duct as the crane moves up and down the runway. As the crane moves, the nozzle forces the rubber valve open. Valve closes immediately after the nozzle passes. This "zipper ventilator" provides fresh air at a rate controlled by the crane operator. Electric heaters warm the air in cold weather.

Case No. 3 concerns the design of



SUCTION produces an almost spherical velocity contour shape around a pipe end. Increased distance means rapid velocity drop, unlike that of a pipe under pressure



VENTILATION can't reduce amount of radiant heat absorbed by a man or object. Cooling results from faster extraction than heat input rate. Radiant-heat shields are economical, can eliminate ventilating equipment and lessen maintenance costs

dust-control equipment for a new ore-crushing and screening plant. All dust sources were tied to a central collector and exhauster. The system's total exhaust rate was 40,000 cfm. Air upstream of the collector was handled in two mains joined at the dust-collector entrance. Suction required to produce adequate air flow in the system was calculated to be 4.1 in. at the collector entrance.

Space limitations made it necessary to put the fan above the collector, each on different floor levels. The two units were connected by a U-shaped section of 42-in. diameter pipe. Distance between pipe leg center lines was about 10½ ft.

In operation, suction at intake hoods proved to be much less than design calculations indicated. An air-flow study revealed a total rate of about 32,000 cfm (8000 cfm less than calculated) and collector's inlet suction was only 2.1 in. instead of the planned 4.1 in. Further study showed that the trouble lay in choice of the fan. Collector's manufacturer had referred flow and resistance data on the plans to a fan manufacturer's rating tables. Fan selection to meet these criteria was made with no apparent consideration of other factors that affected fan performance.

This illustrates what is probably the most serious pitfall faced by plant engineers when designing and selecting ventilating equipment. Fan-rating tables are based on test data obtained under *ideal conditions*. Exhaust-fan inlet and discharge sides have long runs of well-made straight ducts when tested. Conditions that might affect uniform flow of air into the entire fan-inlet aperture are avoided.

Bends at fan inlets may reduce air-flow rate as much as 20%—more if the bend is badly shaped. Since industrial exhaust fans seldom have good inlet conditions, system design capacity will rarely be achieved unless fans are oversized, either as to designated size or speed.

Two other important considerations: (1) Make a careful calculation of pressure loss in local exhaust systems. (2) Choose the right fan motor. With most types of constant-speed fans, the horsepower demand curve rises sharply if air-flow rate increases as a result of piping resistance decrease. So motor horsepower rating should be 10 to 20% above fan catalog requirements. This will prevent motor injury if anything happens to substantially decrease the piping system's overall resistance.

Fluid flow around a suction opening obeys definite laws. Engineers sometimes decrease the opening's size to increase velocity through it. By so doing they hope to give the opening more "reaching out power." This *does* increase the velocity through the suction *opening*, but not at a point in front of the opening and at a significant distance from it. The engineer is usually so engrossed in the job at hand that he loses sight of this important fact. A fact well demonstrated by the formula describing fluid flow: $Q = VA$ where Q is quantity-rate of air flow (cfm), V is air velocity (fpm) at the point in question, A is the area (sq ft) through which the air travels at velocity V. A and V must be measured at the same place and A must represent surface area of the velocity contour. If A isn't changed at the point where we want an increase in V, then we must increase Q to get an increase in V.

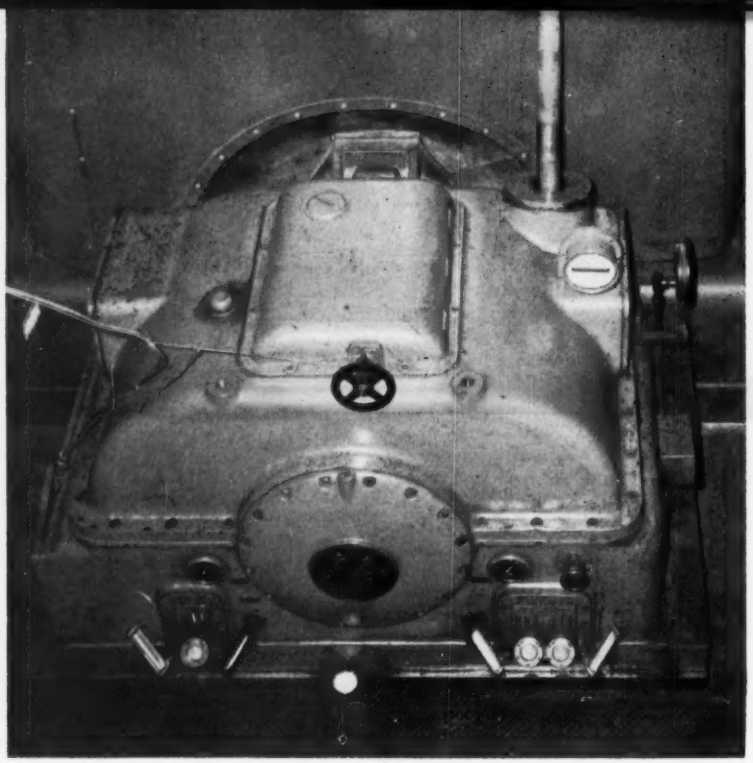
Air flows in an essentially uniform pattern from all unobstructed directions toward a suction opening. Thus, the shape of a velocity contour around a small diameter pipe end is almost spherical; the value of A in $Q = VA$ being about $4\pi r^2$ where r is the distance from the pipe end to the point where V is measured.

Similarly, the shape of a velocity contour produced by a long slot type hood is cylindrical except at the ends where it becomes essentially hemispherical. Velocity drops off sharply in front of most exhaust hoods because of the rapidly increasing value of A.

Pressure openings aren't like suction openings (*Continued on page* 186)

STEAM

By **HERMAN SCHULTZ**
Consolidated Edison Co, New York City



FRONT TURBINE PEDESTAL of 50,000-kw unit; scene of the thrust-bearing repairs

Loose thrust collar, broken key and fouled shaft nut add up to a forced turbine outage. Here's an ingenious time and money saving way to . . .

Repair your turbine thrust bearing without removing spindle

Five steps complete 3-week repair job in 84 hours

1. Connect the air motor to the turbine shaft
2. Install a temporary thrust bearing
3. Turn down shaft and cut off the old thread
4. Install threading rig and cut new shaft-nut thread
5. Mill out keyway for the new step key

► THRUST-BEARING DAMAGE was discovered during a routine turbine outage scheduled to locate the cause of turbine vibration. First, the turbine-generator coupling was unbolted and alignment checked. Then front pedestal housing, shown above, was removed to expose the governor drive and thrust bearing. Close inspection revealed a loose thrust collar that pinpointed vibration trouble to the thrust bearing.

To get a close look at the damage, the governor drive was taken out. Thrust-bearing shaft nut was frozen tight and had to be cut off. When thrust collar and shaft sleeve were removed, we found the step key broken in two. Illustrations on facing page show the extent of damage to these parts.

You may ask—Why not install a completely new thrust bearing and get the turbine back on the line? We eventually did that, but first had to tackle the major problem of machining the turbine shaft to receive another bearing. New shaft diameters were needed at the shaft sleeve and thrust collar. The shaft-nut thread had to be removed, shaft rethreaded and existing keyway reshaped and deepened.

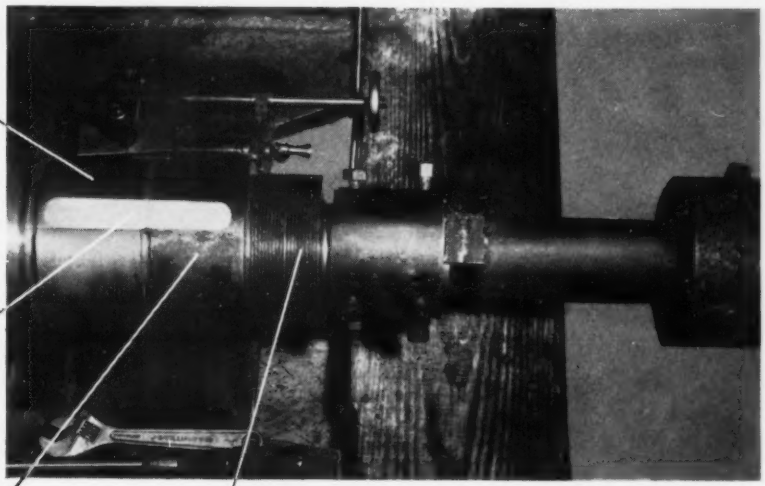
Solution. To remove the shaft and send it to a shop capable of handling repairs on an expensive 8-in. diameter turbine shaft was the obvious solution. But this would involve the time-consuming job of completely dismantling the turbine and assembling it again when the shaft was returned. Conservative estimates placed the total cost at $35,000 with an outage of about three weeks. Thus, our routine shutdown had turned into a forced outage.

For the complete step-by-step story on

Damaged thrust-bearing parts were removed from shaft

THRUST COLLAR, found loose on the shaft, was causing the turbine to vibrate

STEP KEY, compressed by thrust-collar keyway, was broken in two at the step



SHAFT SLEEVE was mounted over step key, between thrust collar and shaft nut

SHAFT-NUT was removed with a saw. Threads had been torn loose from the nut

END OF TURBINE SHAFT was then joined to the air-motor shaft, shown on right. Turbine shaft on this unit had a slotted end, allowing fairly simple hook-up with the air motor. In most cases, there are either threaded ends or some other means of readily making the connection. Bolted collar, next to shaft thread, hides slotted end from view. Square metal extension welded to air motor shaft was fitted into slot to make the connection. Collar was then moved to position shown above and bolts tightened to secure it. With connection completed, air motor was ready to drive the turbine shaft for machining.

Faced with the prospect of a lengthy shutdown, we decided to consider the possibility of machining the shaft without removing it from the turbine. We estimated that it would take three days to design and construct the portable machining rigs needed. Once these were completed, actual machining could be finished in less than a day. So in about four days we would know whether or not repair in place was possible.

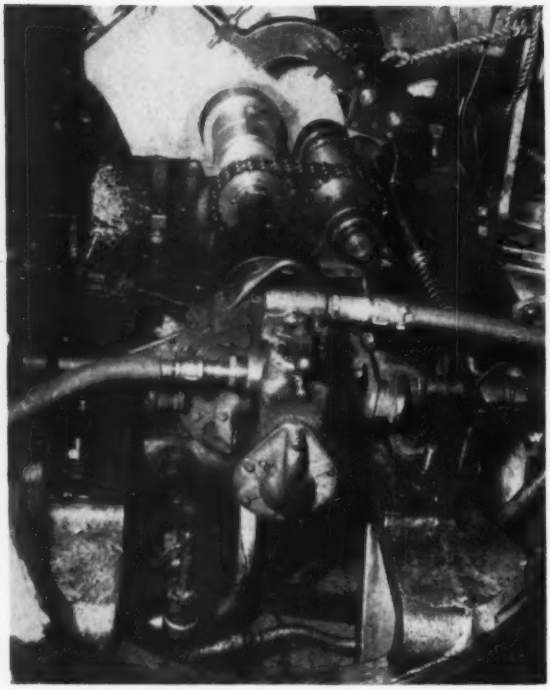
Although we had never tackled a job like this, we were reasonably sure it could be done. If it proved unsuccessful the gamble would only delay shaft repair by three or four days. If we could complete the job on schedule the forced-outage cost would be kept to a minimum and the turbine put promptly back in service. Our decision was to go ahead with plans to repair the shaft without removing it from the turbine.

Machine tools and parts for each step in the repair had to be designed for easy mounting on the pedestal casing at the point on the turbine shaft needing repair. Ordinary steel plates were used to support the machine tools. They were shaped to meet the needs of each individual machining operation and designed to fit existing bolt holes in the casing. Pedestal bolts and nuts were used to fasten the portable rig in place under the end of the turbine shaft. Since most of the bolts were too long, pipe, pipe fittings and even scraps of plate were used as spacers.

Thread-cutting step called for the most preparation and thought. Close tolerances (refer to Step 4, p 117) required several changes in the original design. Materials and equipment on hand were used, where possible, to save time. For this reason chain and sprockets, instead of gears, were used to drive the pilot thread shaft. Pilot thread and follower nut controlled the movement of the tool holder which cut a duplicate thread on the turbine shaft. The principle was simple, but the right type thread had to be used for the pilot shaft. With the saw-tooth thread that we selected, hand pressure on the tool holder was sufficient to keep the tool bit cutting the rotating turbine shaft. A tapered thread could not be cut with this kind of hand-feeding operation.

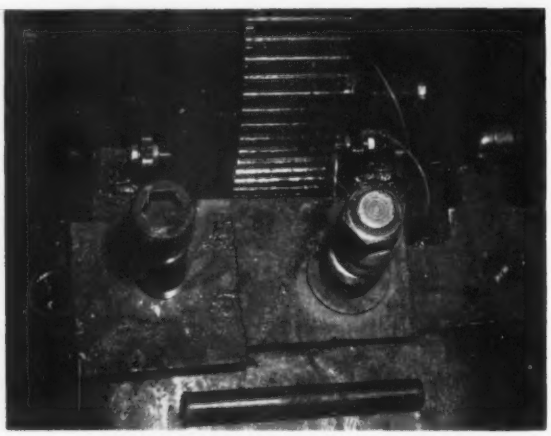
As we had calculated, three days of around-the-clock effort completed construction of all the portable machine tool rigs. The actual machining operations, detailed on the following pages, took us only about 12 hours.

this unusual turbine thrust-bearing repair job see next page ⟶



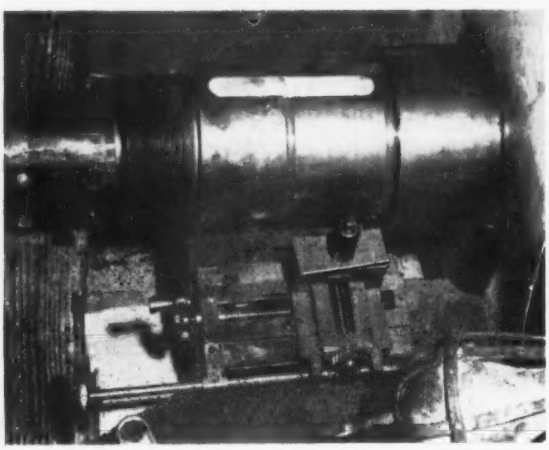
1 Connect air motor to turbine shaft

First step is to locate and/or construct a portable rig to drive the turbine shaft for turning and threading operations. Here an air motor is used to rotate the shaft at 17 rpm. This view of the pedestal area shows the air motor connected directly to the turbine shaft. Inlet and outlet air connections are made with flexible hose. Photo was taken during the threading operation described in Step 4. Notice how the specially prepared brackets support the air motor at the correct elevation and align the motor with the turbine shaft. These brackets are bolted to the casing in the area normally occupied by the governor drive mechanism.



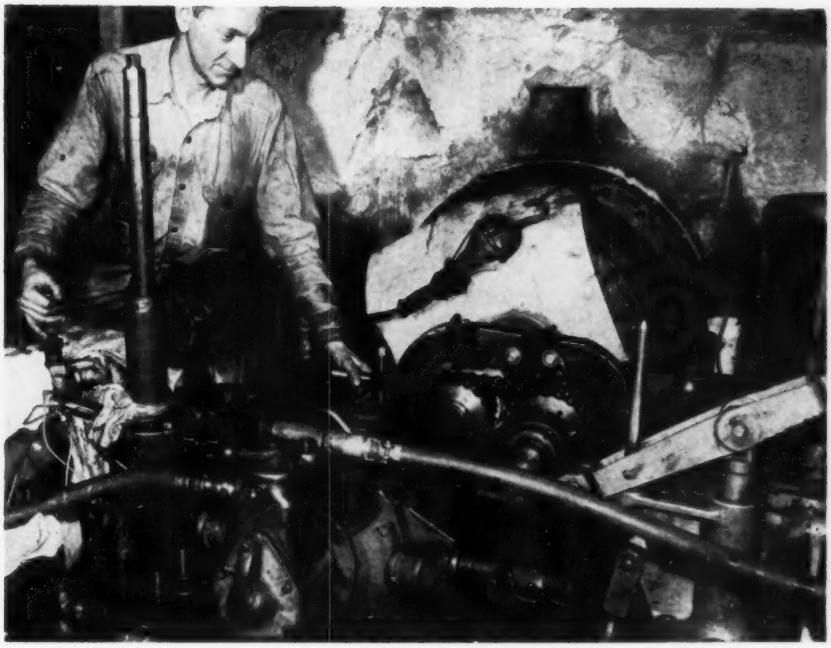
2 Install temporary thrust bearing

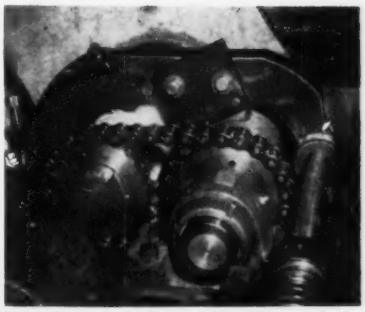
Next step is to devise a way to prevent lateral shaft movement when machining the shaft. View of turning gear at generator end of turbine shows one simple way to do it. First, unbolt the generator coupling and shove the generator back as far as possible. Then take an ordinary U-shaped steel plate and bolt it to the casing with its arms enclosing the turning gear. Brackets welded to each arm contain adjustable screws that are brought to bear against front and back faces of the gear to prevent lateral movement. Notice that ordinary pieces of pipe and plate are used as fillers so original casing bolts and bolt holes can be used.



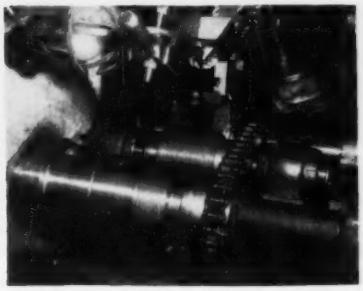
3 Turn down shaft, cut off old thread

Turbine shaft is now ready for machining. Air motor is attached and temporary thrust bearing put in place. Turning gear oil pump lubricates the rotating shaft and prevents seizing. Baffle with hole cut out for the shaft keeps oil from splashing over the work area. Refer to Step 4 for a better view of this baffle. Next, mount the portable compound rest and force-feed combination on a specially shaped steel plate and bolt it to the pedestal casing. Turn down shaft to new bearing diameters at the thrust collar and shaft sleeve. Finally, cut off the old shaft-nut thread and turn it down to the new major thread diameter.



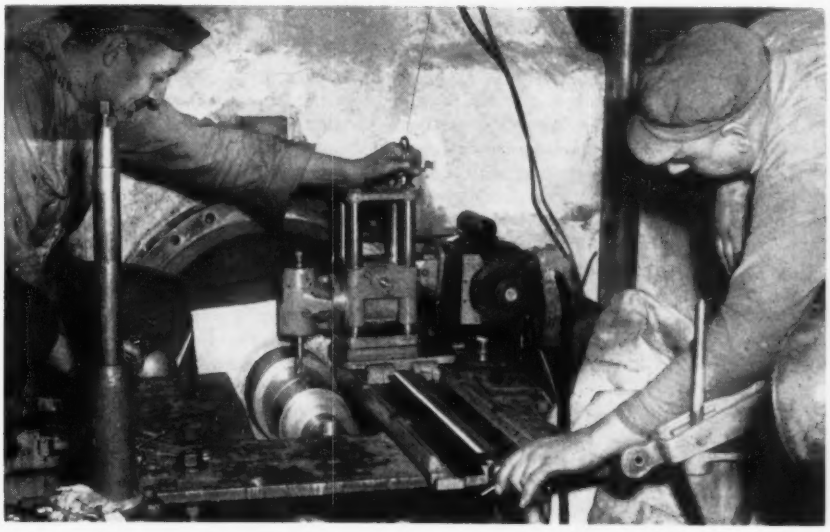


Pilot thread, *right*, guides cut on shaft, *left*, to produce new thread, *below*



4 Install special threading rig and cut new shaft-nut thread

Equipment for thread cutting consists of: (1) saw-tooth pilot thread mounted on pillow blocks to right of shaft (2) chain and sprocket drive connecting turbine shaft to pilot shaft (3) handle-bar tool holder with set screw on handle for follower nut adjustment (4) tool-holder bar rest on left of turbine shaft (5) tool-holder shaft with return spring. Mount bar rest, pilot thread and tool-holder shaft parallel to turbine shaft on special steel plate that bolts to pedestal casing. Use set screw on tool-holder handle to engage follower nut with saw-tooth pilot thread. Then back off half turn or so for clearance. Position tool bit for the initial cut. Start the air motor. Chain and sprocket drives pilot thread shaft at same speed as turbine shaft. Pilot thread follower nut, guides tool holder on duplicate path to reproduce pilot thread on turbine shaft. Thread is cut from operator's right to left keeping set screw firmly on the bar rest (saw tooth makes this possible). After each cut, shaft spring returns handle-bar tool holder to starting position for the next cut.



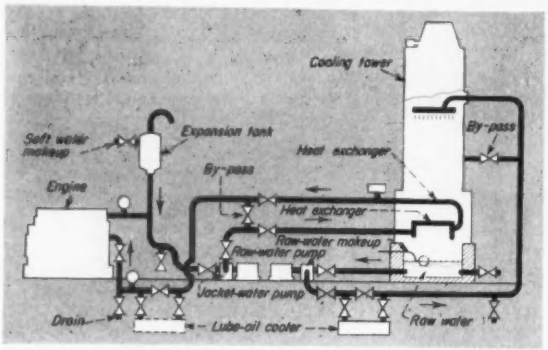
5 Mill out keyway for new step key

Complete the repair by milling out and reshaping existing keyway in the turbine shaft for the new step key. After removing the thread-cutting equipment, detach the air motor from the turbine shaft. Then mount portable milling machine on the steel plate beside the shaft and bolt it to the casing. When machine is correctly aligned, start the motor. Operator on left adjusts depth of cut while operator on right turns the longitudinal feed handle. After milling is completed, turbine shaft is ready for the new thrust-bearing assembly.

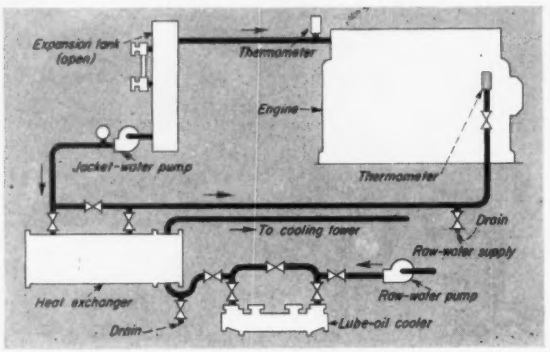
OPERATORS' NOTEBOOK 106

Know your diesel cooling-

Types of closed systems

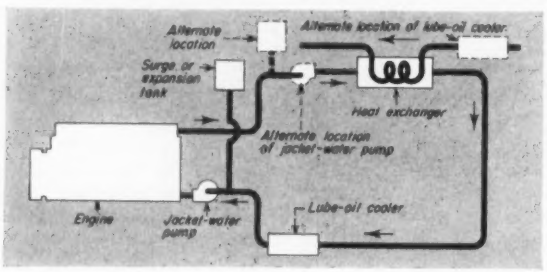


COOLING TOWER of induced-draft type with heat exchanger

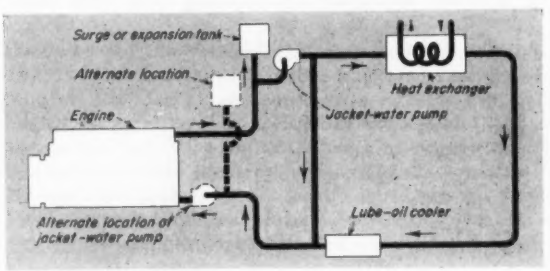


SHELL AND TUBE heat exchanger located inside building

Putting temperature where you need it

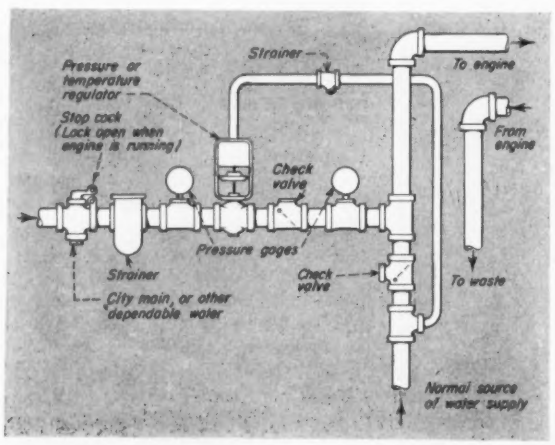


MODERATE TEMPERATURES are held by hookup of this kind



LIGHT TEMPERATURE to engine, lower temperature to lube oil

Emergency supply



EMERGENCY water supply takes over when other system fails

What you must know about diesel

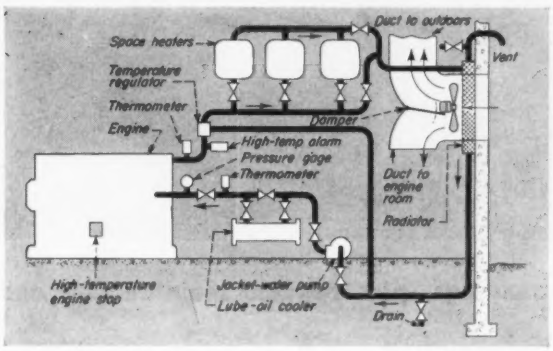
► AMOUNT OF HEAT absorbed by cooling water varies with type of engine and design of cylinders, exhaust manifold, pistons, lube-oil system and anything cooled by the system. Most engines are designed for minimum temperature difference between cooling-water inlet and outlet (from 15 to 20 F). This temperature difference is ideal.

Don't overlook seasonal temperature variations that may freeze your cooling water and congeal the lube oil. Hook up system so all cooling water flows through engine continuously. Never throttle flow to raise outlet temperature. Use only soft or treated water for uniform heat transfer and high efficiency of cooling through engine jackets. A value of about 8 pH is best to prevent deposits in water spaces. Keep system vented so water spaces are always completely full.

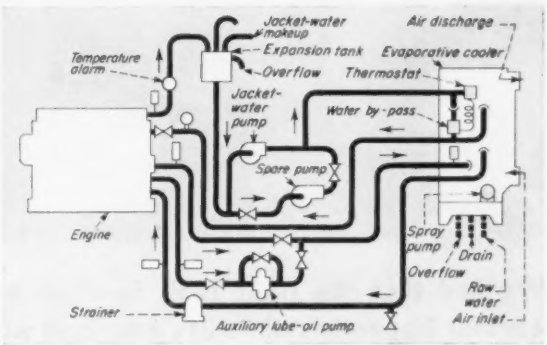
Selecting types of cooling systems shown depends on many factors. One engine maker may prefer the circulating pump with suction from engine, another insists on installing discharge to engine. Good rule to remember: Always install heat exchangers with outlet at top, unless they are vented.

water systems

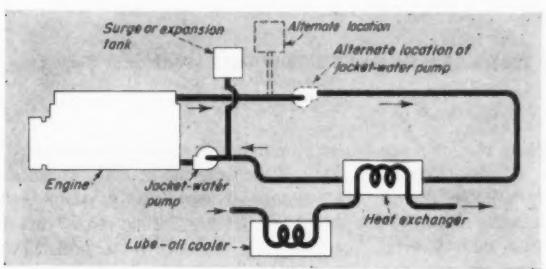
By **STEVE ELONKA**, *Associate Editor*



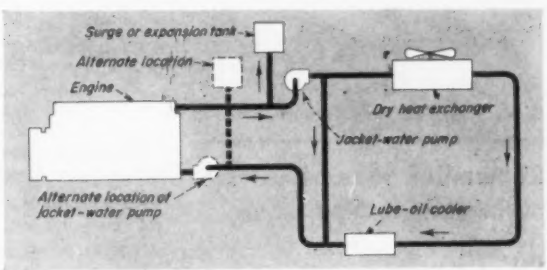
RADIATOR uses extracted heat for heating building spaces



EVAPORATIVE COOLER has raw-water spray pump in its base



HIGH ENGINE TEMP from lube-oil cooler in separate circuit



HIGHER ENGINE TEMP from some water by-passing exchanger

cooling systems

Open system has water flowing through the engine jackets, then wasted or recirculated through a cooling tower. *Remember:* Continuous evaporation in cooling tower or spray pond increases hardness and impurities. This accumulation doesn't remain in solution, but deposits on engine jackets and retards heat transfer. This is the main trouble with open system for diesel engines.

Closed system is best, may have one or two complete circulating systems. *Example:* If a radiator is used with air as cooling medium, use single system with water flowing through engine jackets, then through radiator. Jacket-water outlet temperature and rate of flow water must be specified by engine builder. Keep in mind that raw-water temperatures, rate of flow and heat load govern the type of cooling apparatus you should use.

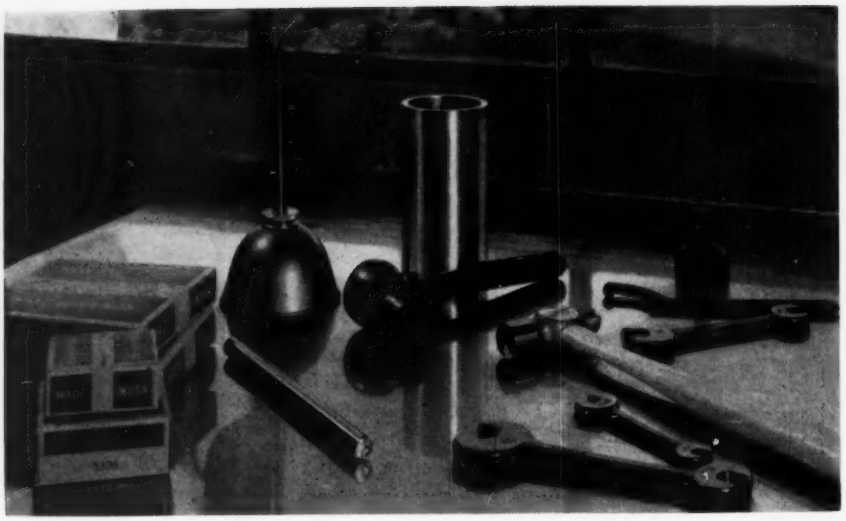
Cooling tower may be one of two types—atmospheric or induced-draft. Atmospheric type depends on natural draft or air movement. Induced-draft type has a fan. In some places it's best to install heat exchanger inside the building. If so, use a shell and tube type exchanger. Then circulate raw water over the tower and through the heat exchanger.

Emergency water connection, sketch, bottom of page 118, assures flow of jacket water if regular system fails. Use this hookup where city water or other source is available at all times. Make sure this water enters system at point where it will be tempered before going to engine jackets.

Alarms warn you when temperatures or pressures go haywire. Automatic shutdown devices stop engine at set temperature or pressure. Use thermostatic controls to automatically adjust flow of jacket or raw water. You can connect them so engine always operates with a fixed outlet temperature from engine or lube-oil cooler, without reducing volume of flow through your engine.

If possible, bring cooling water to normal operating temperature before starting engine. Do this by using heat from another source or by-passing cooling tower, radiator or evaporative cooler until normal temperature is reached.

Courtesy, Diesel Engine Manufacturers Association.



We find that the right tools in clean surroundings, plus regular maintenance and careful inspection of faulty bearings will . . .

Reduce feed-pump bearing trouble

By IGOR KARASSIK and T W EDWARDS, *Worthington Corporation* *

Remember these bearing maintenance tips . . .

DO

- Remove all outside housing dirt before exposing bearing
- Handle new and used bearings carefully
- Use clean tools in clean surroundings
- Handle with clean, dry hands
- Use clean solvents and flushing oils
- Lay bearings out on clean newspaper
- Protect disassembled bearings from dirt and moisture
- Wipe bearings with clean, lint-free rags
- Wrap idle bearings in oil-proof paper
- Clean inside of housing before replacing the bearing

DON'T

- Work in dirty surroundings
- Use dirty, brittle or chipped tools
- Use wooden mallets or rough bench tops
- Handle with dirty, moist hands
- Remove grease or oil from new bearings
- Spin uncleaned bearings
- Spin any bearings with compressed air
- Use cotton waste or dirty cloths
- Expose bearings to moisture or dirt
- Scratch or nick bearing surfaces

► BENEFITS from regular maintenance given in a previous article (POWER, February 1956, p 122) will also pay off for feed-pumping bearings. With the exception of packing and shaft sleeves, bearings need more attention than any other part of the centrifugal boiler-feed pump. Even an overdesigned bearing will give trouble unless properly maintained. Either rolling-contact or sleeve bearings can prove troublesome unless all design and operating limitations are properly considered.

Ball-bearing lubrication. Check the grease in ball-bearing housings every three to six months. For good lubrication and corrosion protection, keep the housing about one-third full. Too much grease causes churning and heating within the housing.

Before adding new grease to a ball-bearing remove all the old grease. If there is a drain on the housing, remove the plug and inject new grease with the pump running. Stop when new grease shows up in the drain. Run the pump for ten to fifteen minutes to bring grease to normal operating temperature and allow the excess to drain off. Housing will then be about one-third full.

Ball bearings can be cleaned on the shaft by using the following steps:

(1) Wipe bearing housing thoroughly, remove grease fitting and drain plug. (2) Free openings of hardened grease with a screwdriver. (3) Inject solvent into bearing housing with pump running. Continue to add solvent until it runs clear from the drain. (4) Flush solvent thoroughly with light oil. (5) Add new grease, replace plug and grease fitting. When ball bearings are oil lubricated, the oil level should be about even with the center line of the lowest ball in the bearing. Use oil-level gage on bearing housing to keep oil level between marked high and low limits. As with grease an excess of oil causes churning and overheating.

Drain oil-lubricated bearings periodically to avoid damage from contaminated oil. Flush out with a thin oil and refill with standard lubricant. On large complicated oil-lubrication systems, such as one with common lubrication set up for driver and boiler-feed pump, gravity flush with a thin oil is not practical or thorough. These systems usually have an auxiliary motor-

*Igor Karassik is Assistant to the Vice-President and Consulting Engineer. T W Edwards is Manager of the Boiler-Feed Pump Section.

driven oil pump in addition to the direct-driven oil pump for normal operation. Bearings are then cleaned in place by following these steps:

(1) Drain as much oil as possible by gravity. (2) Add thin oil and start the auxiliary oil pump. (3) Put a fine screen on the auxiliary pump suction to catch the dirt flushed from the system. (4) Run pump until thin oil, discharging from system into oil sump, runs clear. (5) Drain thin oil to waste. (6) Add the right amount of recommended lubricant. (7) Then check pressure switches and electrical connections so automatic protective features continue to work right.

Ball-bearing cooling. Many serious bearing failures are due to improper cooling. Heat generated by a ball bearing or even a thrust bearing is not excessive under normal operating conditions. So cooling water needed to remove heat is not great. Yet many operators still assume that a water-jacketed bearing calls for the maximum amount of bearing cooling possible.

Too much water overcools the outer race of the bearing and the inner walls of the housing. In a humid atmosphere, moisture will condense on the housing walls and quickly find its way into the lubricant. *Result:* Rusting and early failure of the bearing. Proper cooling is obtained by throttling the water supply to get a definite temperature rise (110-F minimum outlet).

Ball - bearing removal. Generally bearings are mounted on a shaft with either a shrink fit or snug press fit. If possible, use a pulling device to remove the bearing from the shaft. Put the pulling jaws or fingers behind the shoulder of the *inner* race or behind its adjacent sleeve. Never apply pressure to the outer race to force a bearing from the shaft or to the inner race to remove it from a tight fitting housing.

When other parts on the shaft do not interfere, the bearing can be supported by a solid or split ring and an arbor press used to remove the shaft. Initial fit can be loosened by slightly warming the inner race.

Ball-bearing inspection. An experienced man can find the cause of failure by carefully looking at a faulty bearing. Box on right gives four examples of bearing trouble and an analysis of the causes. If you are new at this, study instruction manuals available from bearing manufacturers. Careful diagnoses will frequently help avert a repeat of the trouble.

Remounting ball bearings. Trouble-free operation of a rolling-contact bearing depends on a firm bond between inner race (*Continued on page* 203)

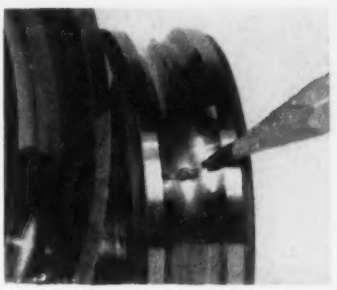
Four examples of bearing trouble

Examine faulty bearings carefully for causes of difficulty to prevent more trouble from same source

Cause _____ **Trouble** _____

Fatigue or foreign body

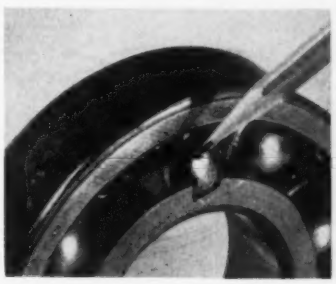
Failure by fatigue would be the ultimate end of all properly applied and maintained bearings if it were possible to run them long enough. But most bearings are scrapped in good condition because machines in which they are used wear out first. Usual cause of fatigue failure is incorrect sizing or wrong application. Flaking shown is probably caused by a foreign body in the bearing.



FLAKED RACEWAY of ball bearing

Dirt or metal chips

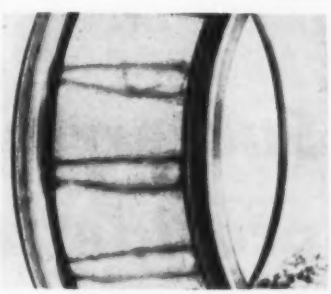
Foreign matter in bearing is most common cause of damage. It can enter during machine assembly or repair, by seepage from air or as a lubricant impurity. Type of damage depends on kind of foreign matter. Fine dirt will produce highly polished races and balls. Hard coarse matter such as metal chips, will gouge the races and jam the bearing. This causes stresses high enough to break the separator.



BROKEN SEPARATOR in ball bearing

Moisture or acid

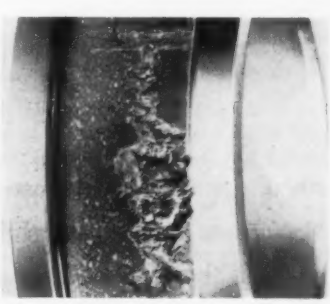
Presence of moisture or acid while bearing is idle for long periods of time will cause the corrosion shown around tapered cone. Other characteristics of corrosion damage include spots, pits and rust streaks on surfaces, and red or black rust spots in bore or outer periphery. Trouble sources include corrosive lubricant, free moisture in lubricant, corrosive atmosphere or presence of moisture.



CORRODED CONE of roller bearing

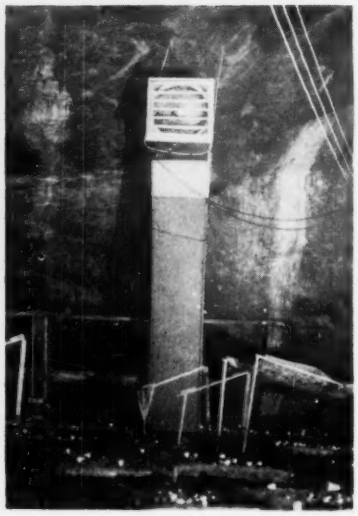
Sparse lubrication

First indication of trouble is a fine roughening of the surface. Then fine cracks develop, followed by extended flaking shown at right. Temperature can increase enough to discolor the bearing surfaces with a definite bluish tinge and cause loss of steel temper. If the lubricant deteriorates or becomes sparse enough, rollers will seize in the cage pockets and on the race. This causes metal smearing on both surfaces.



EXTENDED FLAKING on the raceway

EXHAUST DUCTS run from the extreme ends of the mine to two of the three air shafts available. Thus all mushroom cultivation areas benefit from ventilation



SUPPLY FAN injects conditioned air from adjoining cave to mushroom areas

Subterranean lake provides almost free air conditioning

By **PAUL M STURGES**, *Industrial Consultant, Stone Ridge, N. Y.*

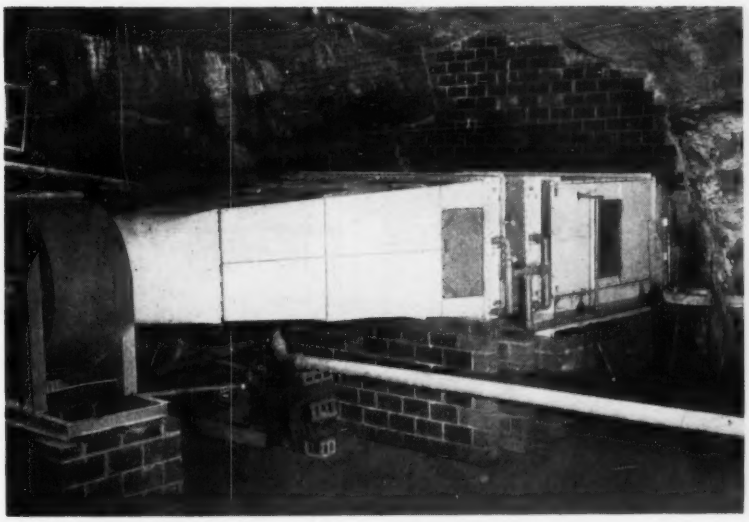
An abandoned natural-cement mine in the Rosendale area of N. Y. State is the scene of the largest mushroom growing operation in the world. Unique? See what you think when you read about its subterranean-lake air-conditioning scheme

► WHAT'S THE CHEAPEST — and best —way to air condition an underground structure that's two-thirds the size of the Empire State Building? Economical operation of the world's largest mushroom growing enterprise hinged, at least in part, on coming up with the right answer.

From the Hudson River at Kingston, N. Y., up the Rondout Creek to Rosendale, lie millions of tons of limestone —The Rosendale deposit. This limestone is the natural cement which was used to build the U.S. Capitol and the Brooklyn Bridge. But after the natural cement industry hit its peak around the turn of the century, and after miners abandoned exhausted diggings, they left behind great caverns. In these caves the Knaust Brothers cultivate some 15-million pounds of mushrooms a year.

Until recently, cave ventilation was mainly by natural convection currents. Air shafts from the mine connect to the atmosphere at substantial differences in elevation. And when outside air was colder than in the mine, resulting natural draft was much like that in a fireplace. When outside air was warmer, air flow reversed itself. Big drawback of the system was that growing mushrooms got fresh air only when it was too cold or too warm for them. And lower parts of the cave were colder than upper regions.

Winter ventilation required large boilers. During the summer, moisture-laden air fogged up the cave, encourag-



AIR-CONDITIONING UNIT receives lake's surface water during winter, lower-level water during summer. Unit consists of two-stage air washer and water coils

VERTICAL SHAFT connection to outside completes air flow circuit in mine

ing growth of parasites—a natural enemy of the mushroom. Thus the need for air conditioning was clearly apparent. But to justify its cost on the basis of a greater mushroom yield wasn't easy.

Largest of the caves, 27 acres and 25-million cu ft, requires a fresh air supply of 25,000 cfm at all times. Temperature limits are 52 to 60 F; specific humidity, 4.3 grains per pound.

Careful exploration of the cave with a view toward air conditioning revealed a subterranean lake containing more than 30-million gallons of water. Air at 49 F was pouring out of a tunnel leading to a cave adjacent to the lake. The rock surfaces not only formed a perfect insulation but were able to absorb or release a vast amount of heat with little temperature change

The prospect of harnessing these natural reservoirs to the air-conditioning project looked highly attractive. But the unknown quantities loomed large. There was no sure way of telling how much precooling or preheating of air could be anticipated over an entire season. And it was impossible to take temperatures of the lake's lower recesses without divers.

To ignore the lake would have meant installing 190 tons of mechanical refrigeration, so we decided to harness nature's forces, accepting the possibility of supplementary refrigeration later.

Front portion of the huge cave (not used for mushroom growing because of the possibility of rock slides) was separated from the mushroom cultivation area by a concrete-block wall. But air could still pick up free cooling or heating from the rock structure and follow a 400-ft path over the lake before entering the air-conditioning unit, photo, above left, and discharging into the cultivation area.

Air-conditioning unit consists of a two-stage air washer and water coils of flexible finned copper, four rows deep, sized for 20,000 cfm. Air-supply fan has a 7½-hp motor. Lake water feeds into the unit via two 3-hp centrifugal pumps. One pump supplies 86 gpm through the coils and then to the first air-washer stage. Second pump sends another 86 gpm to the second air-washer stage. Suction lines for summer cooling run 200 ft to the lake's lower level. Surface water is used for winter heating. Valving permits us to make the changeover from summer to winter operation in a matter of minutes. And existing boiler facilities make up any winter heat deficiencies that may develop in the system.

If lake water should prove insufficient for the required refrigerating capacity, a compressor could be easily installed to operate a water chiller, drawing cold water from the suction of the second air-washer stage. Lake-surface water suction lines would supply condenser water, storing Btus until needed during cold weather.

Second air supply (5000 cfm) from cave next to the lake flows to mushroom cultivation area through ductwork fitted with a 24-in. motor-driven propeller fan.

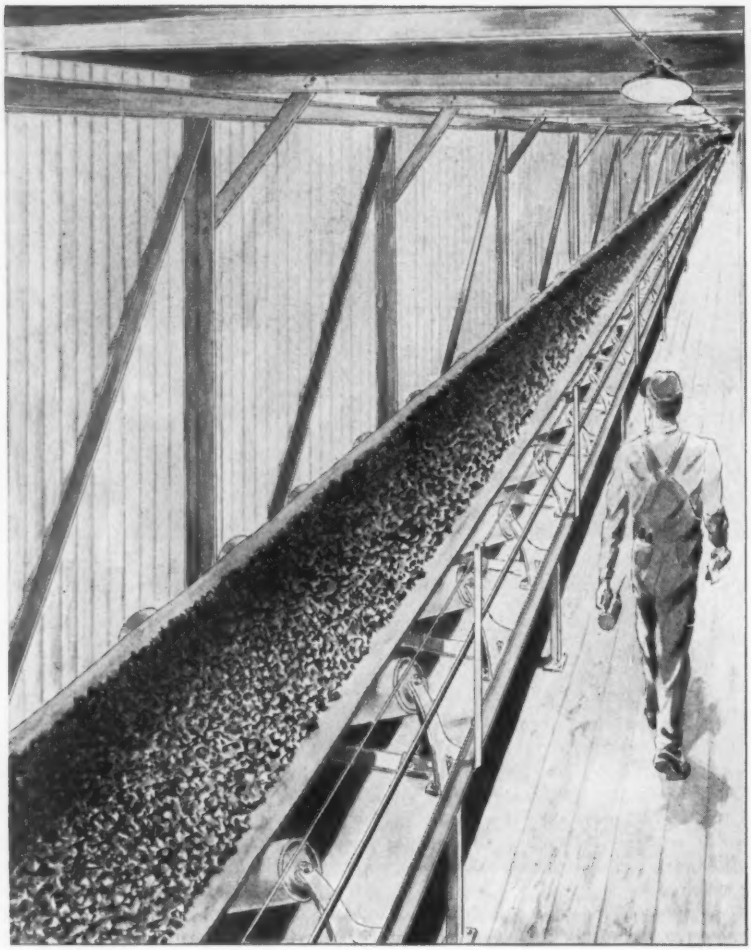
The large cave acts as the main air duct. Exhaust ducts run from extreme ends of the mine to two of the three air shafts available. Thus we get cross ventilation from the supply ducts to all parts of the mushroom area. Exhaust fans (½, 1 and 2 hp) are sized to exhaust 25,000-cfm air so each section gets fresh air in proportion to quantity of mushrooms under cultivation.

When we first put the system in operation, water was supplied to the conditioner at 50-F dry bulb, came out at 53-F saturated. By end of the summer, lower lake-water temperature climbed only 1 F. Air from the adjoining cave, originally sent to the mushroom growing area at 49 F jumped to 52 F. Surface water was up to 55 F, ready for the heating season.

Total design tonnage of the air conditioning is 190. The two 3-hp water pumps are the only power consumers we need to supply the refrigerating effect. Total power consumption of the system is 18½ hp when conditioning is required and 7½ hp when it isn't.

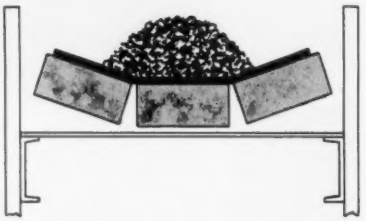
To further chill the mine water during winter (in preparation for summer operation) we will place a coil outside the cave and equip it with a ½-hp fan and ½-hp pump. The unit will be installed in a siphon to recirculate water during the cold weather.

Most important, from the Knaust Brothers' viewpoint: Mushroom growth has responded with a big boost in both quantity and quality.

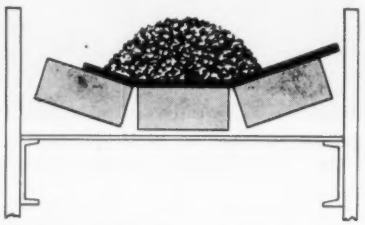


GOOD LIGHTING is centered over the walkway, not the belt. Stop cords should be easy to reach, tight enough to actually work. 1¼-in. pipe makes good handrail

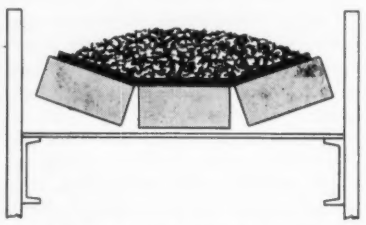
Loading affects conveyor operation



THIS LOAD is too light for the belt, piled too high, not properly distributed



OFF-CENTER LOAD causes belt to wander over the idlers; excessive spill can result



GOOD BELT LOAD, properly distributed, helps idlers keep belt on proper track

Make conveyor-belt operation safer

By W A HYDE, *Oliver Iron Mining Div, U. S. Steel Corp*

► IN OUR EXPERIENCE, 84% of conveyor-belt accidents occur in cleanup operations, mainly in deck cleaning. Other danger points are take-ups, return idlers and head pulleys.

Here's a practical program to make conveyor-belt cleanup, maintenance and operation safer in your plant.

DECK CLEANING

It is almost impossible to teach a man cleaning spill to release a tool caught in a belt in time to prevent injury. So there are three courses of action available: (A) Devise better cleaning systems. (B) Restrict deck cleaning to times when belt is stopped. (C) Keep spill off deck altogether. Let's consider them in turn.

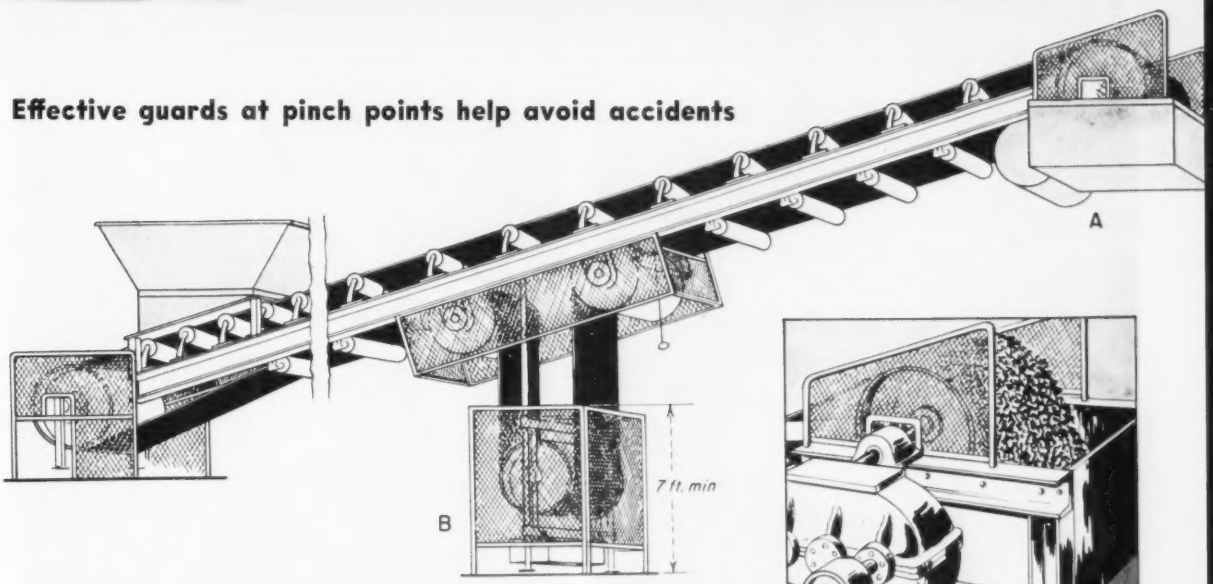
(A) Improve cleaning methods. The obvious solution is to provide better cleanup tools. We have special "low head" scrapers and short-handled shovels, but we have not found any foolproof hand tools.

Automatic cleaning is another solution. One way to do this is to block up the troughing idlers and add edges to the belt deck. Wash with water to clean the deck. This is effective on limited installations where (1) spill is fine material (2) incline is sufficient (3) water may be used freely. But this method is not wholly satisfactory.

Another automatic-cleaning system involves a pitched deck. Idlers are raised and a sloped deck installed with the ridge under the middle of the center idler. This deck works best with washed material of fairly coarse sizes and with a minimum amount of fines. It fails when the spilled material's an-

Note: Adapted from a paper presented at the 44th National Safety Congress, Chicago, October, 1956.

Effective guards at pinch points help avoid accidents

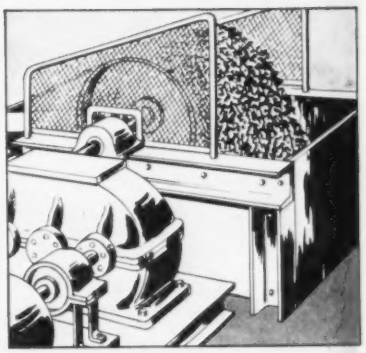


Expanded metal and pipe make a good guard

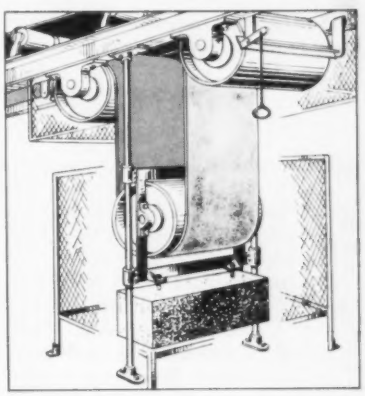
Use 1¼-in. standard pipe and expanded metal to make head-pulley guard. Pegs welded to frame provide for easy removal. Vertical take-up guard can be made from expanded metal and light angle iron. Leave an opening at bottom for cleaning; see that minimum guard height is 7 ft from floor. Bend pulley scrapers, right, remove build-up and prevent damage to the belt.

Ordinarily, block passageways under the belt. Provide properly constructed stiles with handrails if crossing is necessary. If you must allow under-the-belt traffic, provide positive overhead guarding.

Good lighting is another must. Centering it over the walkway lets men see spill or other hazards, permits a better check on condition of belt deck and idlers.



A. Guards for head-pulley and coupling



B. Snub pulley scrapers used at take-up

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gle of repose is greater than the deck pitch angle.

A deck angle great enough to shed many troublesome materials would demand excessive headroom. Also, when it works, this solution moves the cleaning problem from the deck to the walkway beside the conveyor.

Another way to eliminate deck cleaning is to omit the deck. Then spill rides the clean side of the belt to a place where a scraper removes it. If scraper fails, belt carcass suffers serious damage at the first pulley. Clean side of the belt is soiled and drive problems increase. This idea looks good at first glance, but the application has not spread.

"Turnover" belts have eliminated the deck-cleaning problem in some installations. The spill material rides the top cover of these belts and removal of accumulated spill may be mechanized. But practical application of "turnovers" is limited. We still have cleanup problems to contend with.

(B) Restrict cleaning times. Until better cleaning methods are developed, we should restrict all work on and around belts to times when the belts are stopped. Provide all operating and maintenance men with safety locks to secure belt drives while they're working on them. Enforce use of these locks.

We require repairmen to lock out a "lock-out stop pushbutton station" and then attempt to start the machinery at the control panel. When the start-stop button cannot start the machinery, repairman ties a safety tag on the start button at the control panel. If he must enter a machine or equipment where the consequences of a start would be serious, he also removes the main fuse for that machine.

(C) Keep spill off the decks. While locks and safety procedures are highly important, it's better to keep spill off the decks altogether. Here are eight ways to do it.

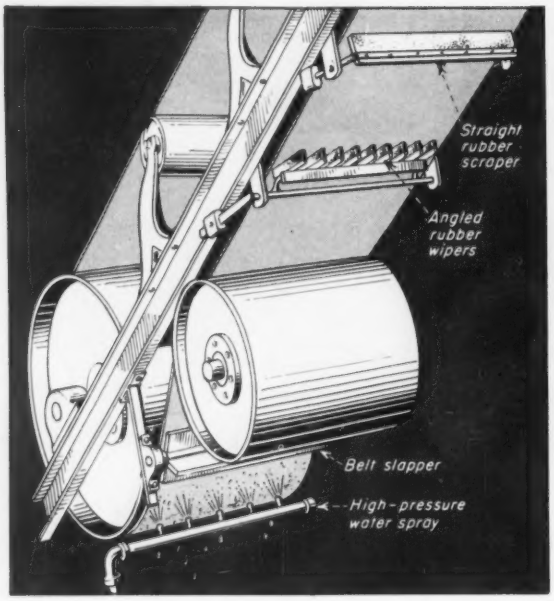
(1) Use a wider, slower belt. Often an additional 6 in. of belt width combined with a proper speed reduces spill and cleanup labor cost as well as maintenance cost.

(2) Provide a firm, well-aligned foundation. Any deviation from the center line or any variation from level in an idler, encourages spill. If you have spill along a properly loaded belt, check the alignment.

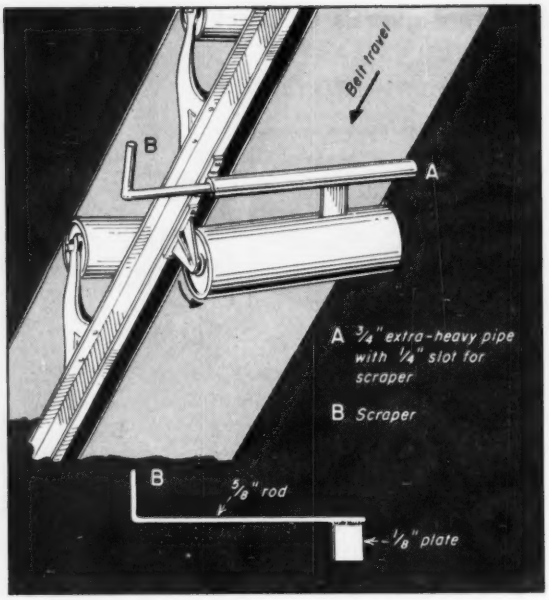
(3) Include ample clearance in the original design to permit some belt movement. Design pulleys, idlers, deck stands and all rubber-carrying equipment to permit 6 in. play on the edges of a belt. This eliminates a lot of spill and edge-wear troubles.

A belt that's too rigidly controlled is always a trouble point. Some room for movement permits the idlers to take hold of the load and bring belt back in line. Avoid use of restrictive idlers, such as side guide stands.

(4) Reduce edge wear. One way is to reverse the channels that carry the belt decking. Instead of mounting the channels with flanges in, presenting a smooth outside face, we now mount the



BELT CLEANING to remove material build-up may involve high-pressure water sprays, belt slappers, wipers and scrapers



RETURN ROLLER CLEANER is hand operated. To use, move scraper along length of roller. Experiment to find best location

channels with flanges out, presenting a smooth face to the belt edge. The smooth back of the channel does not erode quickly and does little damage if belt happens to rub on it.

(5) Use the right idlers for the application. We prefer idlers with a two-degree forward tilt. They seem to help alignment. Objections we have heard about these idlers do not seem applicable to our operations.

(6) Don't overload the motors. Overload damages driving machinery and may shorten life of motor coils, etc. It may also increase your power bill and the added tension may do damage to the belt carcass.

(7) Use the right loading chute. Cut and try — guided by experience and careful investigation of the material flow—is the only sure method of developing a good chute. New tools, such as high-speed cameras, should be invaluable in chute design.

The nature and size of material dictates openings, slopes and sometimes shapes. We have experimented with many ratios between chute and belt width and find that a chute one-half the belt width at the loading point is a good place to start.

(8) Distribute load correctly. Loads should be spread across the width of the belt, not concentrated in the middle. A uniform load gives idlers a chance to get a grip on the belt and steer it back to center, sketches, p 124.

Use self-aligning idlers if necessary. They will work, but we feel that a properly aligned belt does not need them, at least on the troughed side. Self-aligning returns are somewhat more successful in most applications.

TAKE-UPS

The vertical gravity take-up is usually installed close to the head pulley on the return side of the belt. This take-up is frequently a sore spot. Bend pulleys ride on the dirty side of the belt, so build-up is likely to be excessive. This must be removed to prevent belt from wandering off the pulleys. As a first choice, use a hand-operated movable blade scraper installed across the face of the pulley. Cleaning can then be done from a safe platform with no chance of personal injury. Automatic steel-blade scrapers can be used, but maintenance is higher. And there is more possibility of belt damage and high pulley wear. Also, the hand-operated scraper gives operating men the opportunity to take frequent looks at the belt.

Guard take-ups to protect personnel from falling material and from the take-up itself. Never permit traffic under suspended weights.

An obvious answer to build-up on the take-up bend pulley is a thorough cleaning between the head pulley and the head-pulley snub. Where water can be used, see that there are properly designed high-velocity sprays and wiper blades. We have had some success in cleaning belts with beater or slapper pulleys. Here again, make field trials to find the best combination.

Another answer to the bend-pulley problem is to use a tail-pulley gravity take-up, wherever possible. This eliminates the bend pulleys. Also, tail-pulley take-ups and counterweights are easier to guard.

RETURN IDLERS

About 1 in every 10 accidents occurs in conjunction with return idler cleaning. Never try this job with hand tools. Location of return idlers requires a contortionist to even see them. At best, you can see only the bottom side of the belt.

One safe device for cleaning these idlers consists of a length of ¾-in. extra heavy pipe (as long as the belt deck is wide) slotted from end to end with a 3/16- or ¼-in. saw. This is mounted on the conveyor-deck channels in the proper position to permit moving a scraper through the slot to clean the idler, sketch, above right. Be careful to mount the guide so, regardless of wear on the scraper, it cannot be drawn into or through the idler.

Some operators think it is desirable to be able to see the belt's return strand. This can be accomplished by mounting return idlers on separate

(*Continued on page 202*)

Coming bulge in kwhr per worker, points up the need for a fresh look at...

Electrical maintenance — tomorrow

► A LOOK AT 1929 STATISTICS shows that the American economy had progressed quite far, before taking a nose dive. For sure, our 9.3 million workers had a better life with about a 44-hr work week than their fathers who put in a 59-hr stint. And in 1929 workers produced more than three times as many goods as their fathers were able to turn out.

How come? Simply by using some 6900 kwhr per worker. The kwhr was a working partner their fathers knew but slightly. Including these fundamental facts in his opening remarks, GE's Fred McChesney set the pace for the recent "Industrial Productivity Forum" sponsored by General Electric and Public Service Electric and Gas Co of New Jersey.

McChesney pointed out that our nation's productivity is reflected by the Federal Reserve Board index which rose from 97 in 1949 to a 1956 estimate of 142. Best predictions say that by 1976 output per worker will boost industrial production to a high of 281 (POWER, Sept 1956, p 75).

We can be sure that increased use of electric power will play a vital role in this increased productivity figure. McChesney estimates that by 1976 each industrial worker will get a helping hand in the form of 61,300 kwhr, chart, above.

These figures reveal two interesting facts: (1) We will continue to meet demands of a population growing at the rate of about 2½ million people per year. (2) We will do it with an available work force that's hardly growing at all. How will this affect the electrical maintenance picture?

Your job tomorrow will grow as mechanization continues. It will grow and become more complex in the midst of air-conditioned sound-conditioned plants. Lighting engineers, already see use of fewer windows: "black areas by night and bright spots by day . . . a stumbling block to uniform control lighting." This reduction in window space will cut initial cost and heating and air-conditioning losses. Narrow seeing-strips will give workers a psychological comfort.

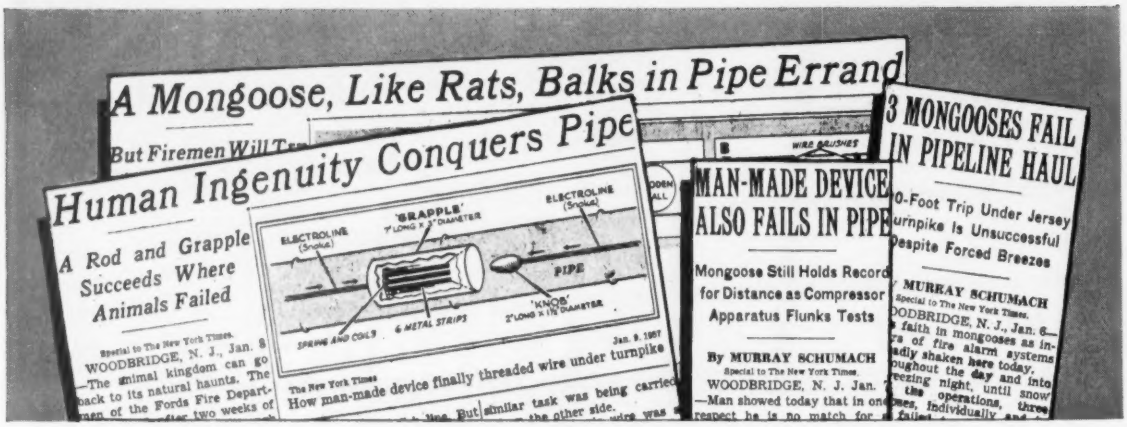
In your long-range maintenance planning, keep in mind that the shift toward automated production throws a spotlight on electrical control with its growing maze of components. Voltages will continue their upward climb, paced by better insulations and improved mechanical designs.

Spurred by economic competition, American industry has adopted the practice of continually modernizing to improve their processes. Today's forward plans peg this area with the term *obsolescence by design*. In each step of this process of obsolescence our production equipment and controls become more complex. True, equipment makers are building-in a high degree of reliability and trouble-free operation. Yet, with tomorrow's industry leaning heavily on round-the-clock performance, the role of electrical maintenance and preventive maintenance assumes greater proportions.

In your industry, as in most others, there's a distinct trend toward higher operating speeds. Since World War II, steel mills have stepped up tin-plate rolling from 4000 to 7000 fpm; copper and aluminum drawing is done at speeds exceeding 5000 fpm; paper machines deliver lightweight products at 3500 fpm and rewinders operate at 6000 fpm.

This points up a fundamental fact: Tomorrow's electrical maintenance men will need more savvy. It's your job to seek out technical men rather than "conduit benders." In-plant training courses for trouble-shooting electricians will grow in some relation to the greater use of kwhr per worker. And of necessity, they will face electrical maintenance problems that are seldom with us today. Unless we misplaced our crystal ball, motor maintenance not directly related to misapplication, will be a rarity. The spiraling growth in insulation technology (POWER, June 1955, p 82) will hold internal motor failures to a most modest minimum.

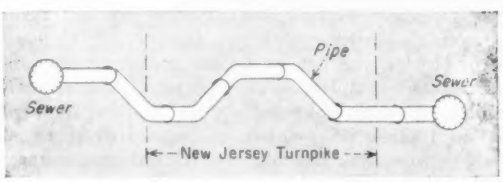
Perhaps the greatest equipment change will come in industrial controls. Introduction of transistors and wider use of semi-conductors will demand a high degree of technical ability from tomorrow's trouble-shooting electricians.


A Mongoose, Like Rats, Balks in Pipe Errand
Human Ingenuity Conquers Pipe
A Rod and Grapple Succeeds Where Animals Failed
'GRAPPLE'
ELECTROLINE (Snake)
PIPE
'KNOB'
How man-made device finally threaded wire under turnpike
MAN-MADE DEVICE ALSO FAILS IN PIPE
Mongoose Still Holds Record for Distance as Compressor Apparatus Flunks Tests
By MURRAY SCHUMACH
3 MONGOOSES FAIL IN PIPELINE HAUL
MURRAY SCHUMACH

Rats and a mongoose started these headlines. But the recent N. J. under-the-Turnpike headache was finally licked by one of . . .

4 tested ways to rod ducts

Engineers with cable-pulling savvy supplied the facts for this roundup to
NORMAN PEACH, *Assistant Editor*



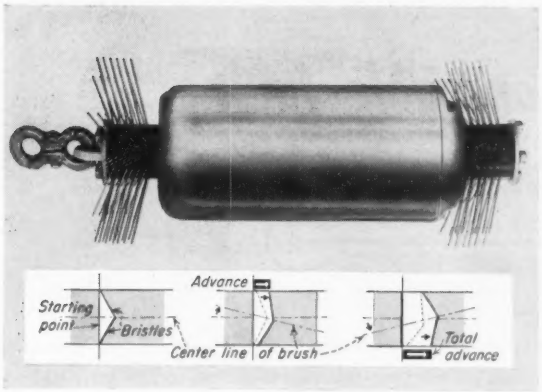
The mongoose story

► ZOOLOGY GOT MIXED UP with engineering down on the New Jersey Turnpike recently, and it made news. The fire department of the town of Fords wanted to run a fire-alarm cable to a new development on the other side of the Turnpike. There was an unused 4-inch conduit connecting sewers on each side of the roadway, see sketch above, which is view looking down on the road. The conduit seemed to be made to order, even if it did have a couple of bends in it.

The next step was to fish a line through the duct so cable could be pulled in. The duct was 730 ft long, too long to rod through from one side with an ordinary electrician's snake. The fire department decided that a rat, following its natural impulses, would race through the duct pulling a string behind it. The string could be tied to a steel wire which in turn could be used to haul in the cable. This mammalian technique was quite respectable around the turn of the century when man and beast worked together at all sorts of tasks. In fact, our own Marmaduke Surfaceblow proved the effectiveness of rats and ferrets by pulling a cable through a duct under a London street. (POWER, March 1956)

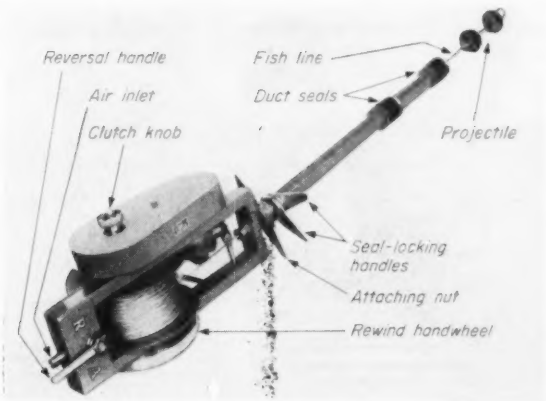
The rats on the Turnpike operation weren't up to expectations, however. Two rats died and six others refused to go all the way. Word of the rodent engineers' efforts spread through the area, and a local resident offered his pet mongoose as an incentive to the sluggish rats. (Rats are aware they are part of a mongoose's diet.) The mongoose raced into the duct so fast that he overshot his mark, and came zipping out the other side. The rat had apparently died of fright, and had to be hauled out by the string. If mongooses behave like this, why bother with rats, reasoned the Fords firemen. So they tied the string to the mongoose. By this time, however, the mongoose had decided there was nothing in it for him, and he resisted further attempts to urge him through the conduit.

Other mongooses were tried while the public waited breathlessly. Meantime, among those who offered suggestions were some volunteers with commercial rodding equipment. The job was finally done with two snakes (mechanical) that connected in the duct.



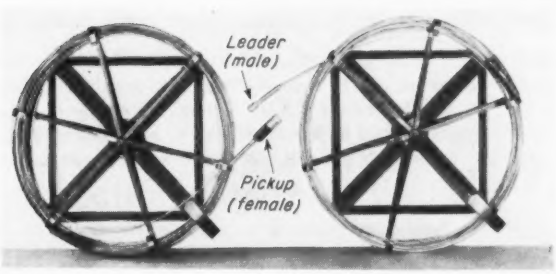
—Electric duct mouse

There are no external rotating parts. Sealed-in motor causes whole mouse to vibrate or "wiggle" at constant frequency. Wire brushes on mouse grip sides of duct. Sketches show how mouse advances. In starting position, center line of mouse is on center line of duct. As mouse wiggles, its center line tilts and upper bristles advance. When center line tilts the other way, upper bristles hold while lower ones advance. This happens every cycle. Mouse moves at speeds up to three feet per second. A 600-ft cable supplies 120 volts, ac or dc, and has steel strands for pulling after mouse is disconnected. Mouse can be used in 3- to 5-in. conduit of any material. It climbs vertically and around bends. It isn't stopped by minor obstructions or water. Complete kit, including two duct mice and cable, costs around $1000.



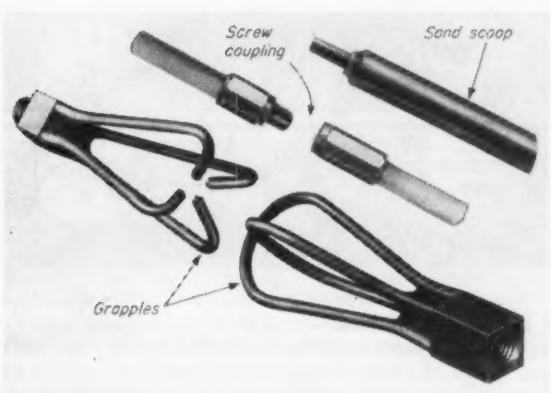
——Pneumatic fishline

Apparatus consists of powerful air gun which shoots a projectile through the duct. Fishline is attached to the projectile. Some models have air motor which mechanically reels in fishline. Projectile has two neoprene cups that fit snugly against sides of duct. Pneumatic fishline is fast and passes around bends with ease. Projectiles are available for ducts up to 10 in., and fishlines for 1000 ft or more. Duct must be airtight and fairly smooth. Projectile is stopped by obstructions that mouse will pass. Compressed air supply is, of course, required. The price ranges between $500 and $600.



———Heavy-duty steel snake

A variety of heavy-duty steel snakes or fish tapes are on the market. They are somewhat slower than the duct mouse or pneumatic fishline, but will pass larger obstructions. Cleaning devices can then be pulled through. Prices range between $10 and $100 for 100 ft. Since snakes must be pushed into the duct, it is better, on runs over 400 feet, to use two snakes that connect when they meet in the duct. Type shown left has male and female couplings that mate easily and hold securely. Line can be pulled either way.



————Duct rods

The term *rodding* comes from time-honored method of connecting lengths of rod together with screw or snap couplings. Rod is pushed into duct a length at a time. It's slow, but it is still the last resort when there is a sizable obstruction in the duct. You can get attachments for scooping out mud and sand, picking up stray objects and even cutting concrete. A jar hammer is made that gives strong impact to tool. Rods cost from $2 to $3 apiece, are two- to four-feet long.

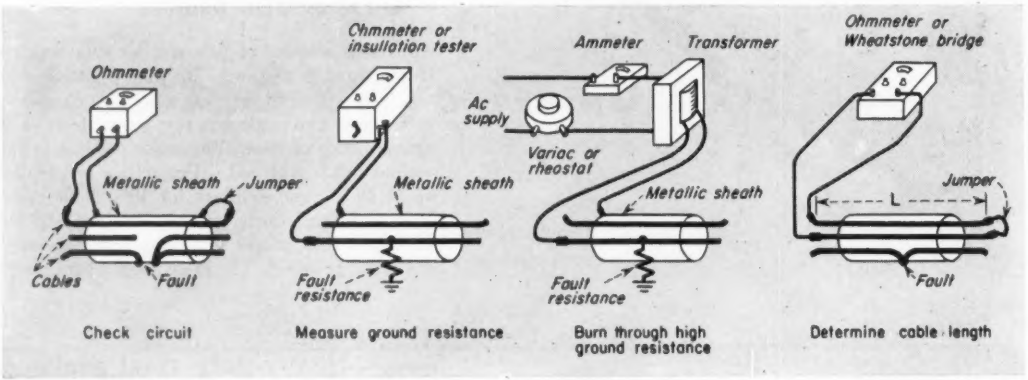
Plant Electrical Fact File

NO. 12: CABLE FAULTS

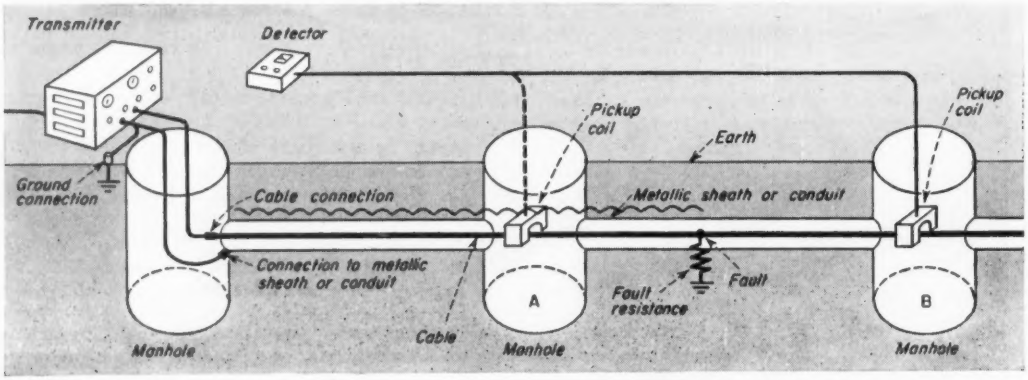
5 tips on cable-fault location

By NORMAN PEACH, *Assistant Editor*

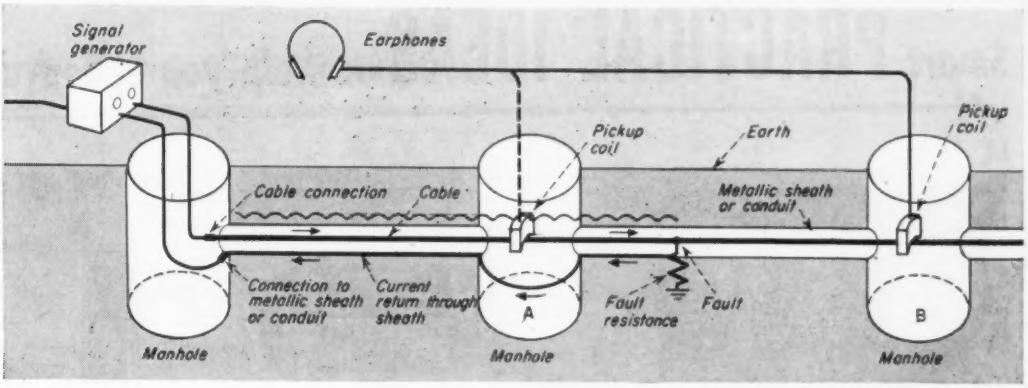
► LOCATING FAULTS of power cable in ducts buried underground and in concrete walls or floors can be a trying job. Here are some tips on well-known methods. Tests are not as simple as they may look, however. To avoid error, look into technique further after you've decided which procedure is best. There are many tests based on use of a Wheatstone bridge. Or you may be able to find the fault using ammeter and voltmeter to measure resistance.



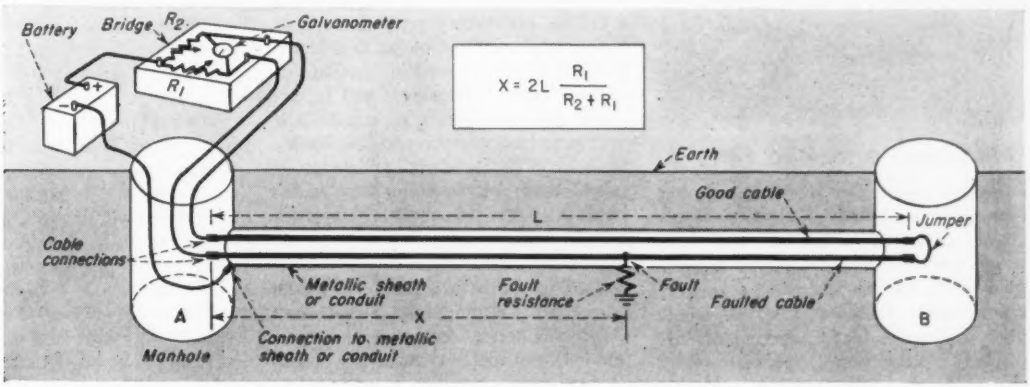
1 **PRELIMINARY TESTS** are made to determine which cables in sheath or conduit are grounded, shorted, open or intact. Measure resistance of ground fault with both ohmmeter and megger (that is, using high and low voltage) to see if resistance is constant. If unsteady, fault tests are difficult. Unsteady or too-high fault resistance can be burned through to steady low value by trickle current (about 5 amp). Records of cable lengths should be kept. Length can often be calculated by measuring the resistance of two intact conductors.



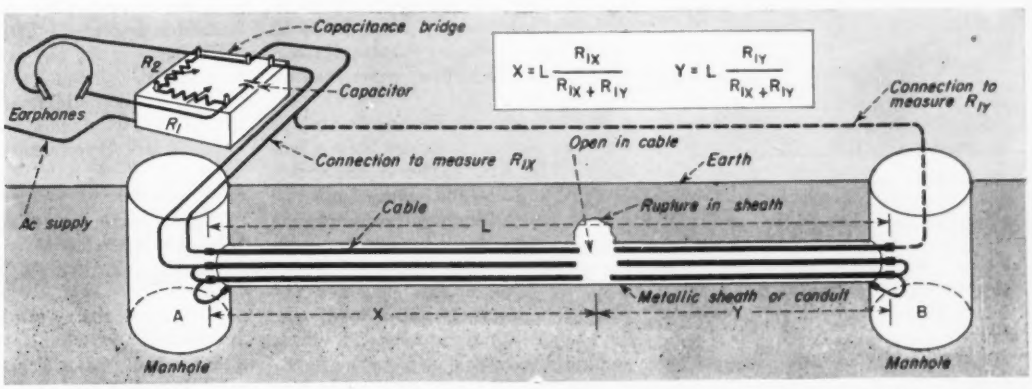
2 **IMPULSE TEST** transmitter sends dc surge along cable. Wave is reflected from fault. Pickup coil placed on cable (or as close as possible) detects wave up to fault, does not respond beyond it. Surge is repeated every few seconds. The high voltage generally blasts through the fault, making a loud report. You can often locate fault easily and accurately by listening at manholes. Extra-sensitive pickup loop is designed to trace underground cables through earth. Impulse transmitter also can be used for direct-current insulation proof test.



3 **TONE TEST** employs signal generator, pickup coil and earphones. Simplest signal generator is a battery-operated vibrator. Electromagnetic field of signal current is picked up, and since return is close to cable, total field is weak. Place the sensitive pickup coil as close to the cable as possible. No tone is heard beyond fault, if fault has low resistance. However, error is possible if fault resistance is so high that cable beyond fault is charged capacitively. Tone method can be used to locate shorts between the conductors in the cable.



4 **MURRAY LOOP** is simplest of Wheatstone bridge tests. An intact conductor of same length and resistivity as faulted conductor must be accessible at point beyond fault. The two conductors and ground return from fault become part of bridge. Since length of a conductor is proportional to its resistance, you can find distance to fault X if total length L is known. Adjust bridge arms R_1 and R_2 until bridge is balanced (galvanometer at zero). Insert R_1 and R_2 values in formula. For shorts, use one of shorted wires for return.



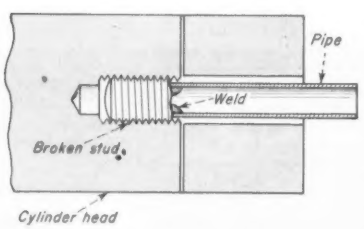
5 **LOCATING OPENS** that are clear of ground can be done with capacitance bridge. An ac supply is used. For method illustrated measurements are made at both ends. R_{IX} is value when bridge is balanced, measuring from the X side of fault. R_{IY} is value when bridge is balanced, measuring from Y side. Bridge is balanced when earphones detect no tone. If one conductor is intact, you can make test with one measurement. Connect Y section to intact cable at manhole B. Use the sheath as a return and connect to Murray-type loop.

Smart PRACTICAL IDEAS to help you speed up your

Homemade mobile fan

We made portable stands and comfort fans for our plant, photo. Frames are scrap ½-in. pipe, motors are from junk yard. Handles are bicycle handlebar grips. Crutch feet on legs are very important as fans are moved on smooth floors. Wheels, blades and guards are from electrical supply house. Coat of paint finished these mobile and safe fans for about $15 each. Be sure to measure doorways and stairways before building yours to save embarrassment.

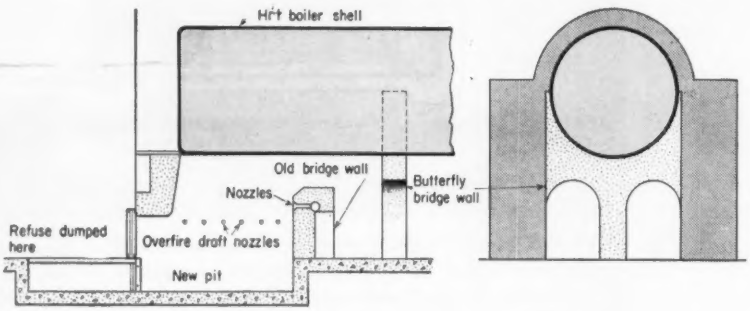
B M KECK, *Austin, Minn.*



Removing broken stud

We had to remove a hard-to-get-at stud bolt, sketch. Broken stud bolt was on the crank end of a large compressor cylinder head. Stud was broken about 5 in. below the surface. We inserted a piece of 1-in. pipe into the hole. Broken stud was then arc welded to the inside of pipe. A few light taps with a hammer loosened it. Then a pipe wrench was used to back the stud out.

R M ANDERSON, *Phoenix, Ariz.*



Revamped standby boiler is an excellent incinerator

Until a year ago, our steam plant had a 115-hp, hrt stoker-fired boiler and an 85-hp, hrt hand-fired boiler as a standby. Steam is for heat and process.

Besides usual warehouse and factory waste, our shoe factory creates leather, neolite and rubber scrap. These cannot be burned in the furnace because of excessive smoke. So scrap was hauled away by a man who had an outlet for it. But, unfortunately, he stopped his service.

Hauling scrap to a dump or public incinerator was expensive. While cost of an incinerator was high, biggest problem was where to put it. A ceramics firm came up with a plan for using our small boiler for an incinerator. At the same time it would make steam, if needed.

Boiler had an old type setting with grates about 30 in. above furnace's bottom. First we dug an 18-in. pit so grates could be brought down to floor level. Pit was extended six feet in front of boiler for ash removal. Then moved 12 in. to rear to increase grate surface. That makes the new grate surface 54 x 66 in.

Midway between the regular bridge wall and rear of boiler we built a butterfly bridge wall. Center arches of this came 12 in. below the boiler's bottom.

Built into bridge wall is a steel pipe manifold with six ¾-in. nozzles, opening on fireside 27-in. above the grates. Also, six ¾-in. nozzles enter the furnace through the sidewalls. Nozzles are 22 in. above the grates for overfire draft and turbulence

Motor and fan for underfire draft is mounted on angle iron frame over passageway between two boilers. A steel duct leads down through the floor and setting to ashpit. Motor and fan for overfire draft are on a wall extending from opposite side of boiler. Air reaches jets through two 3-in. steel tubes. Air supply is regulated by butterfly dampers. Overfire draft is 100 cfm for each set of jets.

A steel plate that can be raised covers ashpit in front of boiler. Refuse is dumped on this plate and shoved into the furnace through a sliding door. An electric-eye smoke detector in the breeching tells us about smoke going up stack. It also helps us regulate drafts.

Incinerator has been operating for over a year. While not absolutely smokeless, we have had only one warning from smoke inspector. So we haven't had to install a gas or oil burner in the combustion chamber.

Boiler is connected to main header through a stop-check valve. At times we pass steam to main boiler, which carries 80 psi. But pressure and quantity of steam is usually too low and supply too uncertain. So we don't feel like spending money to connect steam to a feedwater or domestic hot-water heater.

We have carried our processing load by burning coal. But I wouldn't like to try heating the building if temperature dropped to much below freezing.

W H C BISHOPRIC, *Toronto, Ont.*

Do you 'full-flow' test your fire pumps . . .

every year? Factory Mutual engineers do. And they sure find some surprising things. Many fire pumps discharge only about half their rated capacity at half their rated pressure. Trouble is caused by all kinds of junk lodged inside the impellers—wood, fishing line, etc. Be safe, test your fire pump right now, and at least once every year.

operation and maintenance jobs

STEVE ELONKA, *Associate Editor*

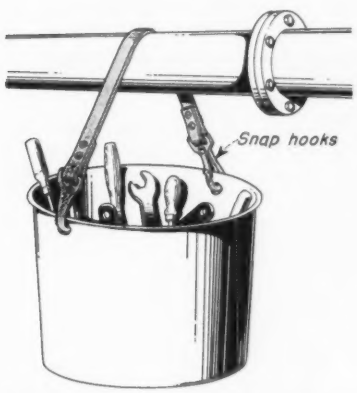
Don't paint—galvanize!

We now purchase only galvanized-steel grating in our chemical plant for interior and exterior use. But we still have considerable painted-steel gratings installed around the plant as walkways, pump covers, etc. When paint fails on gratings it's not economical to repaint. Instead, we let the paint fail until it's almost all gone. Next, we sandblast or use a caustic bath to remove the remaining paint. Then we have the cleaned gratings hot-dip galvanized.

We find that the six cents per pound we pay for galvanizing is cheaper than repainting. You don't have to remove all the rust before sending the gratings to the galvanizer. His pickling baths will remove rust, but not paint. Galvanizing old grating is obviously much cheaper than buying new grating. It also has advantage of already being cut to proper fit.

Also, we have completely galvanized some new welded grating stair assemblies after they were welded in our shop. Again, the cost of galvanizing proved much cheaper than painting.

R D IRELAND, *Dearborn, Mich.*



Safe overhead tool pail

Today we are very conscious of safety. When working overhead with tools you should always wear a strong tool belt with each tool secure—same as electrical linemen use. If you need more wrenches and parts, take them aloft in a safe container that can be secured nearby. We use buckets or pails, sketch. Snap-on hooks permit strap to be unhooked, passed around a pipe or beam.

C H WILLEY, *Concord, N.H.*

What would you have done?

During a long shutdown of our powerhouse, we had only the emergency diesel, generating ac current of 100 kw 3-phase at 380 volts. That wasn't enough for our needs. To find a solution, I had to bone up on what I had long forgotten about synchronous generators. We had to keep running our plant's emergency water pump.

Pump is run by either an 87-hp emergency diesel or a 59-kw squirrel-cage 380-v 3-phase induction motor. Power is transmitted by a V-belt pulley on the pump shaft.

We started the emergency diesel while the pump was run by V-belts from the induction motor. When the motor got up to about 1500 rpm (we work with 50 cycles) we closed the line starter of the motor and accelerated the diesel to get over synchronous speed on the motor. That promptly began to feed to the line. In this way we got about 45 kw out of the diesel, besides some water from our pump.

Service with this setup of alternators showed the advantages of using a synchronous alternator. They are: (1) no synchronization (2) no voltage regulation (3) no difficulties with the load distribution. Of course there has to be a source of ac from which the synchronous alternator can take its excitation. What would *you* have done?

G LUERTZING
Santa Fe, Republica Argentina

Here's what I would have done

In POWER, Dec 1956, p 139, H M Neuhaus tells how he protected an oil heater. He mentions mild-steel pipe at standby temperature of 1200 F that failed. Noting that case-hardening steel in a hydrocarbon gas atmosphere causes brittleness due to carbon transformation, he suggested lowering the standby temperature to 900 F, which solved the problem.

Method used by Neuhaus was practical and showed ingenuity. But since carburization or graphitization was causing tube failure, it would have been better to use pipe and tubing having a chrome content. A chrome-moly steel is well-suited for operation at temperatures to 2000 F in a hydrocarbon gas atmosphere. This material is used extensively for tube stills, oil heaters and other heat-tranfer equipment by the petroleum and chemical industries. Besides resistance to brittleness, these alloys also possess properties to counter creep resulting from high temperatures.

Cost for the higher alloy-steel materials is usually greater than carbon and carbon-moly steels but the longer operating period resulting from reduced outages will lower operating costs. Of course welded joints are preferred to flanged and screwed joints.

H B WAYNE, *Woodhaven, N.Y.*

Turn page for more Practical Ideas ▶

More PRACTICAL IDEAS

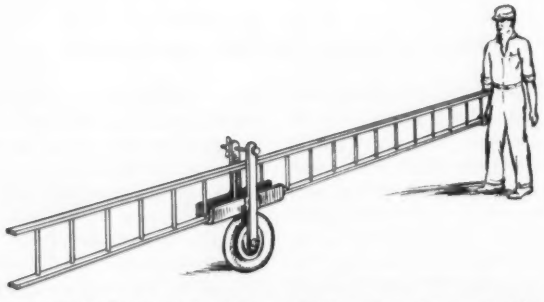
Begins on page 132

Here's your trick of the month

Photo shows a new band welded to a large waterwheel-generator runner without dismantling the scroll case. Shaft and runners were turned at 1½ rpm by hooking a 90-to-1 speed reducer to shaft's end. Then, with temporary rig shown, faulty section of band was machined to correct diameter. A 1x8-in. stainless-steel bar was rolled, giving a ring of about 7-ft diameter. This was cut into halves, slipped over and clamped to the runner, then tack welded.

When completely welded, the ring was machined to the correct diameter with the installed rig. Incidentally, all welding was done in the ideal down position by inching the runner around as required with the driving mechanism. This method saved time.

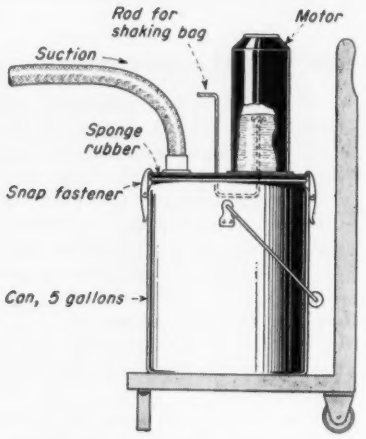
L McWILLIAMS, *Shawinigan Falls, Que.*



Have you tried a ladder dolly for long ladders?

It's easy to make a ladder dolly. All you need is some flat bar stock, a piece of channel iron and a discarded truck or barrow rubber-tired wheel. You can either weld, bolt or rivet the parts together. Dolly shown enables one man to handle a long or heavy ladder with ease. Ladder can be pushed while steering, or pulled. With high cost of maintenance and the manpower shortage, it enables one man to do a two-man job.

C H WILLEY, *Penacook, N.H.*



Do you need a good nut-and-bolt inhaler?

We have many small oil- and coal-burning boilers that must be de-sooted periodically. So we bought a second-hand horizontal tank-type vacuum cleaner for the job. It worked fine except the bag wouldn't hold enough dirt. So we rebuilt it to fit our needs.

First we mounted the cleaner's motor and fan vertically in the lid of a 5-gallon paint can. Bag is held vertically by a stiff wire, bent and extended out of lid, sketch. Before we unlatch the can for emptying, we give this wire a few pumps up and down. That shakes the dust down into the can so we don't have to remove the bag.

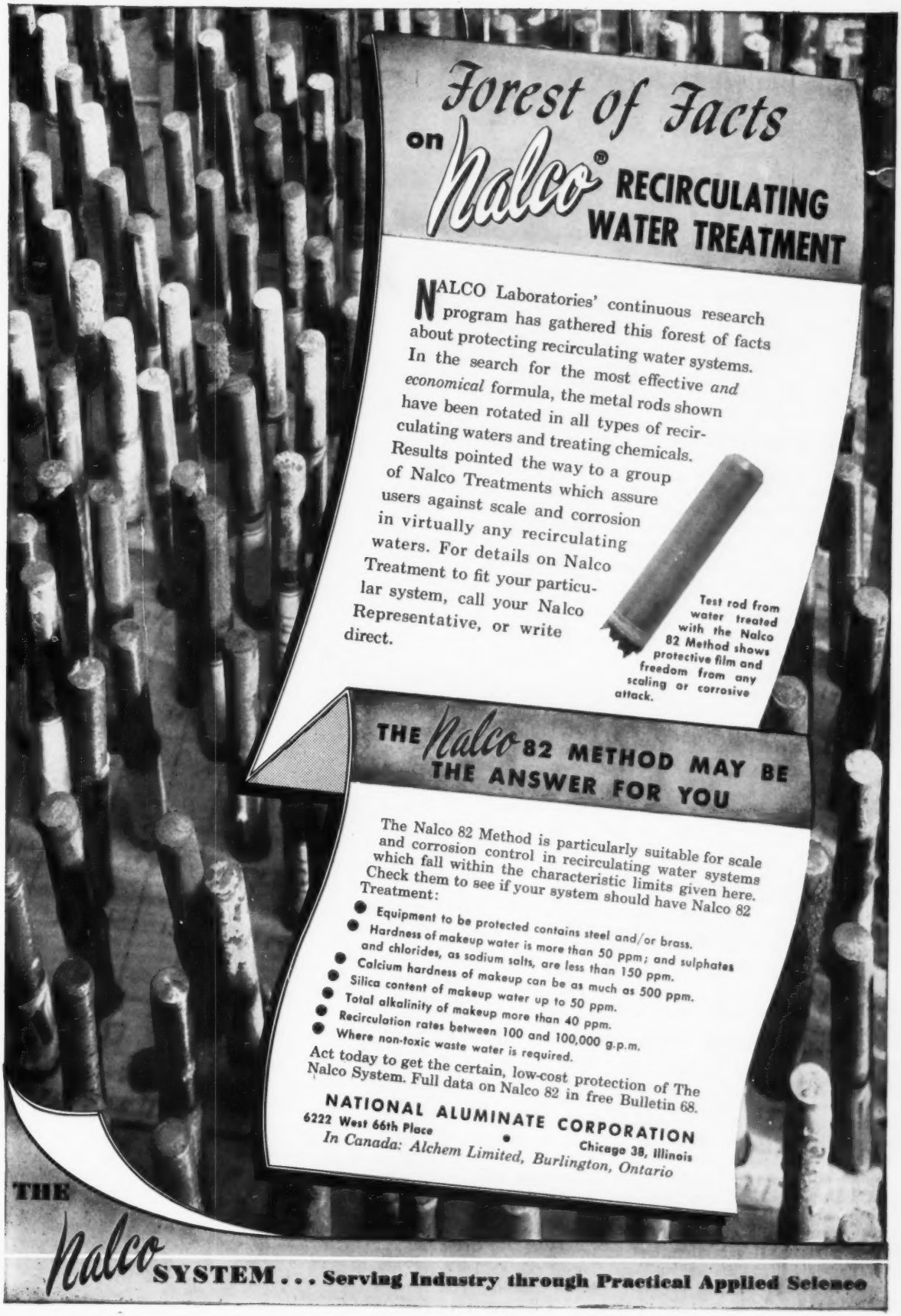
We mounted this cleaner on a two-wheeled cart so we can move it to any part of the plant with its attachments and hose. The motor's ball bearings are for horizontal operation, but they seem to work OK in this vertical position as the motor is light. We get a kick out of hearing the nuts, bolts and lumps of stuff klunk as they hit the bottom of the can. We seldom open the can.

D TREPANIER, *Bella, Bella, B.C.*

Do you know . . .

if your pump's suctions are hooked up properly? If your pump is losing its battle for efficiency because of a common piping fault? These and many other pump questions are clearly illustrated with more than 1500 sketches and photos in the new *Plant Operators' Manual*, McGraw-Hill Book Co.

Turn page for more Practical Ideas ▶



Forest of Facts on Nalco® RECIRCULATING WATER TREATMENT

NALCO Laboratories' continuous research program has gathered this forest of facts about protecting recirculating water systems. In the search for the most effective *and economical* formula, the metal rods shown have been rotated in all types of recirculating waters and treating chemicals. Results pointed the way to a group of Nalco Treatments which assure users against scale and corrosion in virtually any recirculating waters. For details on Nalco Treatment to fit your particular system, call your Nalco Representative, or write direct.

Test rod from water treated with the Nalco 82 Method shows protective film and freedom from any scaling or corrosive attack.

THE Nalco 82 METHOD MAY BE THE ANSWER FOR YOU

The Nalco 82 Method is particularly suitable for scale and corrosion control in recirculating water systems which fall within the characteristic limits given here. Check them to see if your system should have Nalco 82 Treatment:

- Equipment to be protected contains steel and/or brass.
- Hardness of makeup water is more than 50 ppm; and sulphates and chlorides, as sodium salts, are less than 150 ppm.
- Calcium hardness of makeup can be as much as 500 ppm.
- Silica content of makeup water up to 50 ppm.
- Total alkalinity of makeup more than 40 ppm.
- Recirculation rates between 100 and 100,000 g.p.m.
- Where non-toxic waste water is required.

Act today to get the certain, low-cost protection of The Nalco System. Full data on Nalco 82 in free Bulletin 68.

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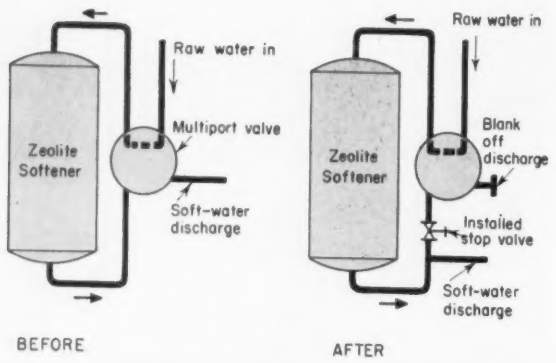
THE Nalco SYSTEM . . . Serving Industry through Practical Applied Science

More PRACTICAL IDEAS

Begins on page 132



Now valves don't leak and less chemicals are used

We have several softeners equipped with multiport valves. Raw-water slippage through these valves ranged from 1 to 6 parts per million hardness. We spent a lot of time and effort, used a lot of spare parts trying to eliminate this slippage, with no success. As valve wore from continued use, raw water slippage increased.

To solve problem, I installed a stop valve in softener piping, sketch. Then I changed the soft-water discharge line as shown. That licked our trouble and also reduced valve maintenance.

We supply a neighboring industry with process steam periodically. During these times our boiler-water makeup is about 30%. Stopping raw-water slippage reduced our chemical costs by 30.4% since making this fairly simple improvement.

During normal softening run, stop-valve is closed and no soft water enters multiport valve. During regeneration, stop valve is opened and procedure is normal. Stop valve is again closed when softener is placed in service. Since making changes shown, soft water is zero hardness at all times. Besides, our boilers are much cleaner and cost of keeping them clean is much lower.

C J WERDERITCH, *Clinton, Iowa*

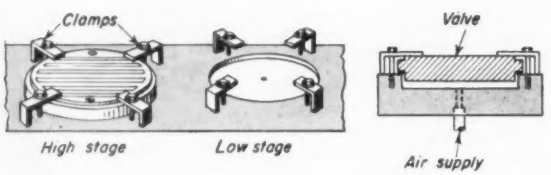
BEFORE

AFTER

Repair coal shutoff gates

Our cast-iron coal cutoff gates corroded badly. Cause was water seeping through soft coal. First photo shows gate after 30 months of service. Second photo is same gate after we repaired it, using 20-gage, type-304 stainless steel. This material was bent on a mandrel and slipped over the gate's edges. We drilled ¼-in. holes through the stainless steel and cast iron, then used copper rivets. Exposed cast iron was painted with hot asphalt. It remains to be seen how long these gates will last. But one gate has been in service 12 months and shows no sign of damage from corrosion, erosion or wear, which is encouraging.

E W MCKNIGHT, *Chapel Hill, N. C.*



Why don't you check your air-compressor valves for tightness?

We have a lot of air-operated equipment in our plant. Air is supplied by 200-hp air compressors that have feather-strip valves. Because leaky air valves in a compressor can cut down efficiency so much, we overhaul our feather valves at regular intervals.

I learned the hard way that air valves usually look OK when they are overhauled. But, to be sure, you must test them. If our valves looked OK, we would clean them and put them back. But since making our valve tester, we found valves might look OK but still leak badly. There are nine feathers in some of our valves. Now our tester shows which feathers and seats leak. We overhaul only the bad ones.

We made two testers and mounted them on a stand, sketch. One is for high stage and one for low stage. Gasket is placed under valve body, holding lugs are tightened and air turned on. Air comes in through bottom of tester. I highly recommend testing not only air, but every type of valve before installing it in any equipment.

F E ZIEGELMANN, *Fullerton, Calif.*

My biggest boner

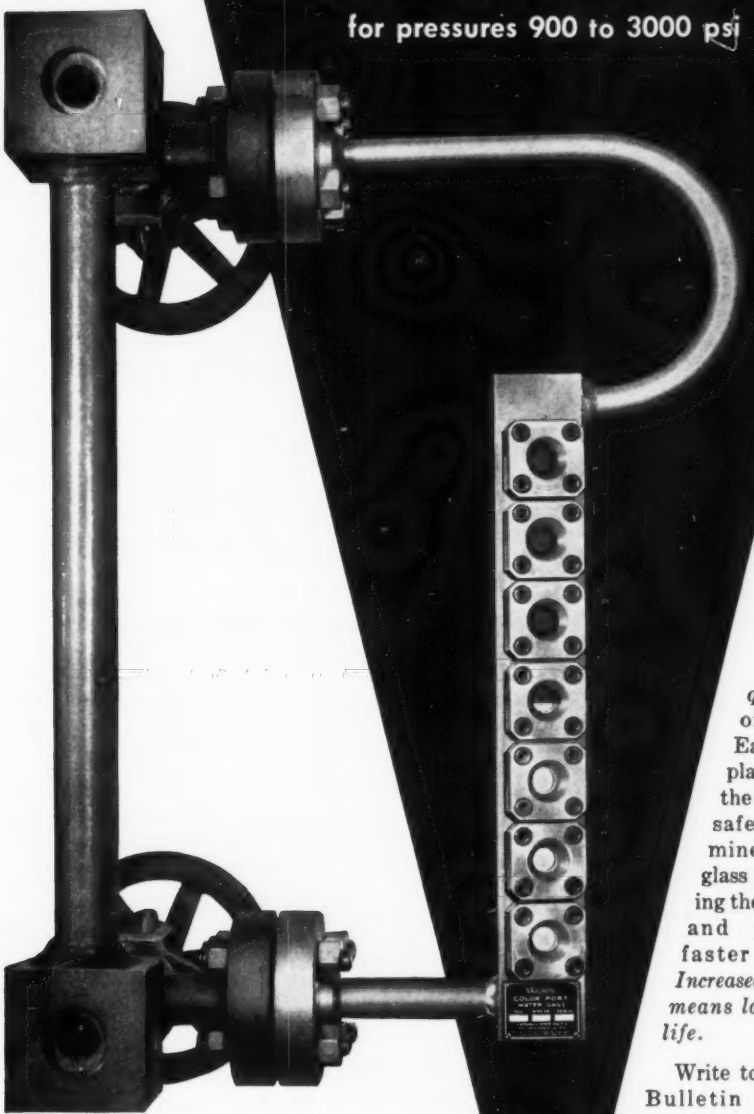
Please turn to page 204

NEW FROM YARWAY!

COLOR-PORT

BOILER WATER LEVEL GAGE

for pressures 900 to 3000 psi

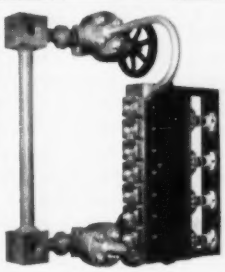


- *two-color readings!*
- *reduced maintenance!*
- *increased availability!*

Now Yarway offers brilliant two-color boiler water level readings, combined with simplicity of gage maintenance and increased availability.

With the new Yarway Color-Port Gage, water space shows green, steam space shows red. A full gage is all green and an empty gage all red.

The Color-Port Gage is *serviced quickly in place* by simple replacement of individual cover-glass assemblies. Each cover assembly is held solidly in place by four socket head capscrews and the "floating assembly" design applies safe predetermined loads on glass ports, reducing thermal shocks, and permitting faster warm-up. *Increased availability means longer service life.*



Side view of Yarway Color-Port Water Level Gage with illuminator, circulating tie-bar and Welbond gage valves.

Write today for new Bulletin WG-1814, completely describing Yarway Color-Port High Pressure Water Level Gages.

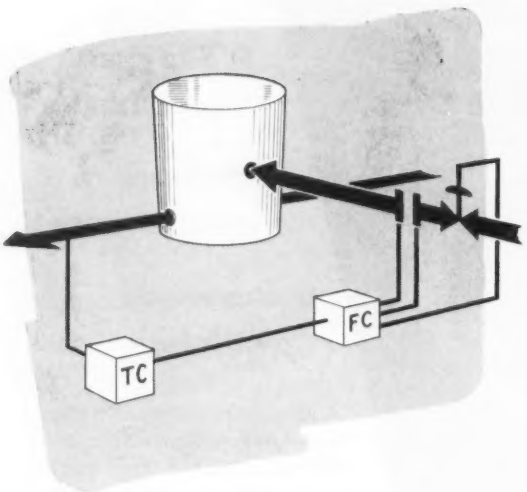
YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Penna.

BRANCH OFFICES IN PRINCIPAL CITIES.

YARWAY WATER LEVEL GAGES

Have a PLANT PROBLEM? *Tap the*



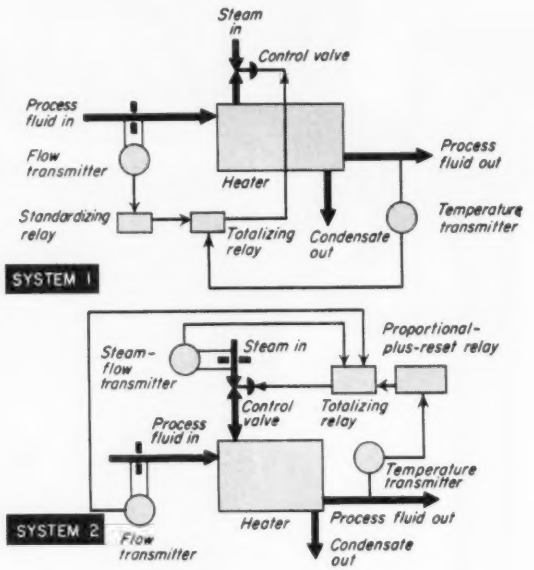
The problem

Should controllers be reverse or direct acting?

Our food-processing plant is planning to add several steam-heated process heaters. Arrangement calls for a temperature controller sensing temperature of the liquid leaving each heater. Flow controller measures steam flow to the heater and also receives an air signal from the temperature controller. Air signal from the flow controller then actuates a control valve in the heater's inlet steam line.

Desired result is to have a constant liquid outlet temperature by controlling steam flow to the heater. I'd like to know whether we need reverse- or direct-acting temperature controllers; reverse- or direct-acting flow controllers?—*PDO, December Power*

The solutions



Here are two possible systems

Let's assume that steam pressure is roughly constant. Then steam temperature (probably saturated) is essentially constant. For these conditions, System No. 1, above, will yield best control. It measures the process fluid flow and positions the control valve directly, trimming final valve position as needed, to maintain a constant process-fluid temperature. System provides proportional action between process-fluid flow and steam flow. And the valve is repositioned by a standardized air signal from a reset-action temperature controller.

If the heating steam pressure varies widely, then a tie-back signal from steam flow, System No. 2, above, provides the best possible control for *PDO's* application.

C E HATTON, *Drexel Hill, Pa.*

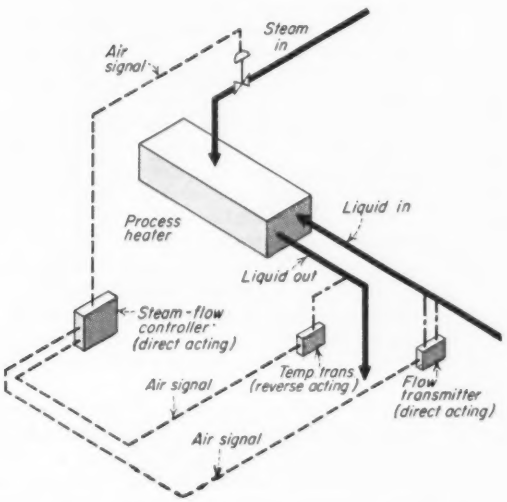
Use reverse-action controller to protect food process

A controller with reverse action should be used by *PDO* to protect against excess fluid temperature if control air supply fails. (Control air pressure decreases as controlled variable increases.) In addition to this, and in case steam supply fails, a low-temperature measuring element should be installed in the fluid discharge to sound an alarm and/or close a control valve in this fluid supply line. Here, too, control valve should be reverse acting, to stop flow if the air should fail. Control system would then work right.

A J BREUGELMANS, *New York, N. Y.*

know-how of over 45,000 Power readers

HOWARD KALLEN, *Associate Editor*



Measure liquid instead of steam

First, I think that liquid flow is a more suitable variable to measure than steam flow. Steam flow depends on liquid flow, so why not start at the beginning? Liquid temperature leaving the heater is the main variable and should be used as the main signal for controlling steam flow.

Sketch, above, shows the system I would recommend. Measure both liquid temperature and flow. Then transmit this information to a two-element controller. Temperature transmitter should be reverse acting; flow transmitter, direct acting; controller, direct acting. Controller sends an air signal to a flow-control valve in the steam-supply line. Valve would open on increasing pressure, close on air failure.

With this system, the temperature impulse fixes the final valve position but the flow transmitter anticipates any temperature change caused by a change in liquid flow.

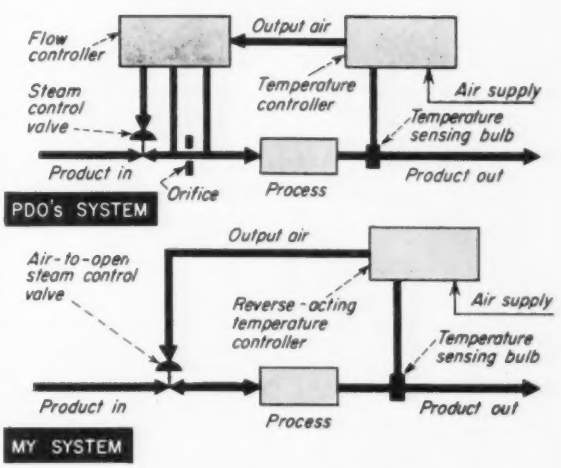
H DePAOLI, *Project Engineer*
Air Products, Inc, Allentown, Pa.

Controller should match valve action

Once the selection of valve action has been made (air-to-open or air-to-close) the choice of reverse- or direct-action flow and temperature controllers is already settled. If the valve is reverse acting (air-to-open) then an increase in flow over the set point should close the valve, making the flow controller direct acting. An increase in the measured variable decreases the controller output. A temperature increase should also tend to close the valve. Thus the temperature controller should reduce its output signal.

If the valve action is air-to-close, the flow and temperature controllers should both be direct acting.

R H KENNEDY, *Waterbury, Conn.*



PDO has two choices

There are two possible answers to the question that *PDO* poses. If he uses an air-to-open steam control valve, both controllers should be reverse acting. If steam control valve is air-to-close, both controllers should be direct acting.

Assuming that too high a temperature will harm the product and over pressure will damage the process vessels, I would recommend the air-to-open steam control valve with reverse-acting controllers. Then if air supply fails, product and process vessel are protected because steam control valve closes on loss of controller air signal, sketches, above.

I believe the job can be done without the flow controller. Steam-heated process heaters have enough time lag without adding more lag. And with *PDO's* scheme, maintenance as well as initial investment are doubled.

F STERNE, *Assistant Instrument Engineer*
Raybestos-Manhattan, Inc, Passaic, N.J.

Decide what happens when air fails

PDO's process temperature controllers should give constant liquid outlet temperature with either reverse- or direct-acting controllers if heat exchanger and valve are designed right.

Main factor is to decide what happens when the instrument air supply fails. With reverse action on both controllers, air failure would cause underheating; direct action would cause overheating. It's up to *PDO* to decide which condition is less desirable for his food process.

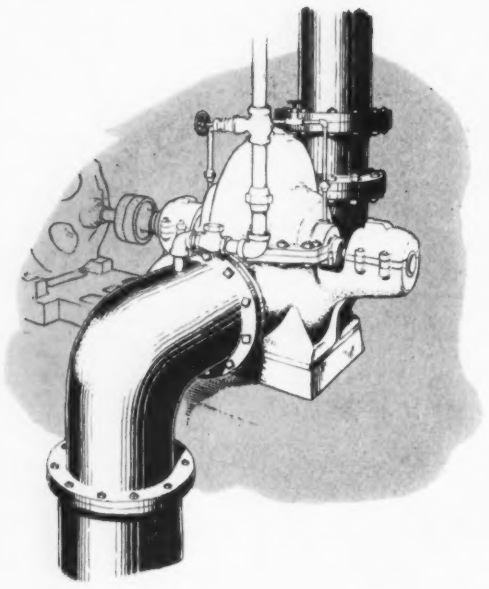
P DAVIDSON, *Ticonderoga, N. Y.*

Want help with your plant problems? Send your design and operating headaches to us. We'll give Power readers a whack at them.

Turn page for info on fire-water systems ▶

More PLANT PROBLEMS

Begins on page 138



The problem

How can we supply water to fire-fighting system at all times?

I'm engineer for a small hospital that's located close to a beach. We must use a salt-water supplied fire-fighting system because the village supply is inadequate and unreliable.

How can we have a reliable supply with a pump that must draw about 24 ft from extreme low tide? How can we avoid fouling with marine growths?

Our area is regularly hit with severe winter storms, ruling out a wharf. The beach is about 100 ft long and, except for a thin layer of gravel, it's solid rock.

The pump and motor installation is no problem. But we need a permanent suction arrangement that's relatively trouble-free.—*DT, December Power*

The solutions

Don't use salt-water system

A salt-water fire-fighting system will lead to corrosion, storm damage, priming trouble, fouling, etc.

The village supply may be inadequate to supply directly the large flows required to fight fires and it may be unreliable at times, but it still holds the key to a better more-reliable fire supply.

DT should provide ground level or underground storage at or near the hospital. He can fill it from the village system during off-peak hours or after midnight when there is little or no demand on the water system. Storage can be kept full by a float-operated valve or by manual operation during periodic inspections. A fire pump alongside the storage, in a pump pit, would provide positive suction pressure at all times and eliminate all priming problems. Alternate solution: Install a deepwell turbine-type pump on top of the storage tank with pump bowls submerged close to tank's bottom. Pump's drive can be a motor or engine—or both.

Divide the storage tank in two or more sections to maintain at least half of the storage at all times. Tank can then be drained for inspection or repairs, one section at a time.

Amount of storage and fire flows required varies with size and type of building and on the occupancy hazard. *DT* can get this info from any fire-underwriting association.

If village distribution system can't supply its own peak demands and fire flows, storage on the distribution system might well be the answer to village's problems too. I would suggest that the hospital and village look into the possibility of cooperating on a joint storage project.

J A NOVARRO, *New Haven, Conn.*

DT should use a concrete sump

A cylindrical silo-type sump of reinforced concrete will reduce the possibility of storm and tide damage. A reliable constructor could examine the site to determine the best method of anchoring the structure to the ocean floor.

The vertical section of pipe, from the foot valve to the elbow, should be flange connected for periodic removal to clear or repair the foot valve.

A priming plug at the pump would be necessary for smooth operation. *DT* should take a trial run to make sure the foot valve isn't leaking.

If a battery-started prime mover is used, the battery should be connected to a small trickle charger.

A sump with an internal diameter of 10 ft would contain 587.5 gal of water per ft of depth below lowest annual tide.

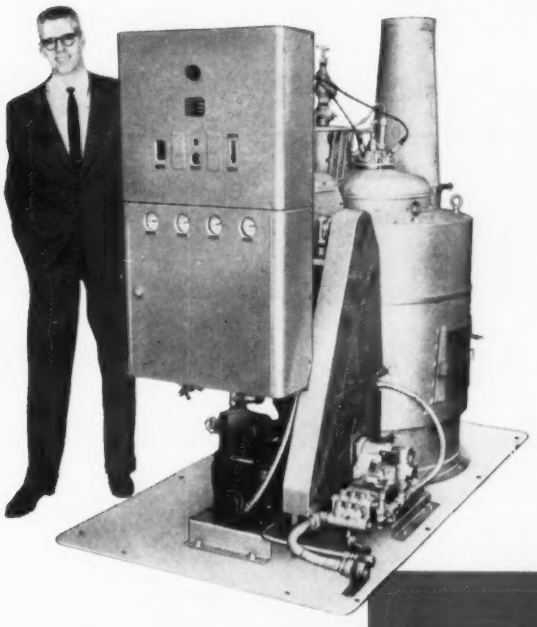
J B JENKINS, *San Diego, Calif.*

Install larger-size suction pipe

Under the conditions that *DT* describes, he'll have a tough time completely avoiding marine growths in his suction line. He should simply expect these growths and plan his installation accordingly. Chances are they'll gradually build up to about a 2-inch thickness and then grow no further. He can get around this problem by increasing the size of the suction line to operate properly with growths.

J SPARKS, *Seattle, Wash.*

For more on fire-water systems and new questions, turn page ▶



don't use floor space for your boiler room

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you can put it on the roof— on a balcony—or hang it from the ceiling

PAY FOR YOUR STEAM THRU FLOOR SPACE SAVED!

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- Develops up to 27 H.P. per 1000# of weight.
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- Full ASME approved.
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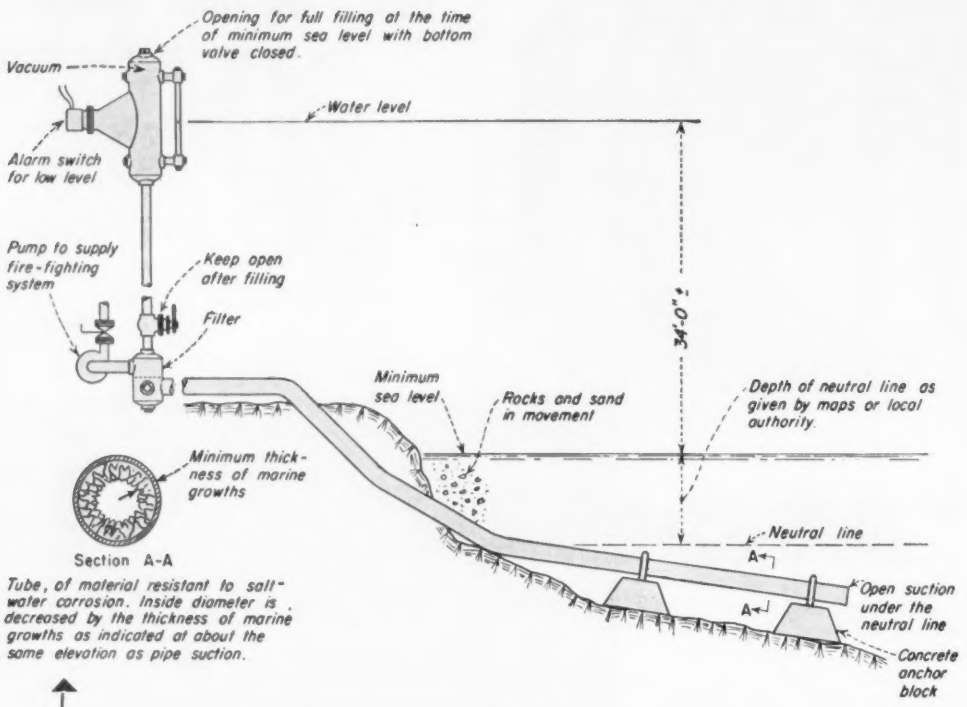
More PLANT PROBLEMS. Begins on page 138


Opening for full filling at the time of minimum sea level with bottom valve closed.
Vacuum
Water level
Alarm switch for low level
Pump to supply fire-fighting system
Keep open after filling
Filter
34'-0"
Minimum sea level
Rocks and sand in movement
Depth of neutral line as given by maps or local authority.
Minimum thickness of marine growths
Section A-A
Neutral line
A
A
Open suction under the neutral line
Concrete anchor block
Tube, of material resistant to salt-water corrosion. Inside diameter is decreased by the thickness of marine growths as indicated at about the same elevation as pipe suction.

Here's how DT can supply water to his fire-fighting system

J BORESTA, *West Englewood, N. J.*

Your March problems

1 How can we design diesel cooling for cold-weather operation?

We have a diesel-electric plant that uses four 1200-hp diesels and direct-coupled 912-kva generators. Diesel cooling is with evaporative water coolers.

Our plant is in an area where outside air temperatures fall to 30 F below zero, with strong winds. If outside air is used to circulate through the evaporator there is danger of freezing the coil; the spray pan fills with ice and the intake plugs with frost. If inside air is used, the full use of spray water is required during peak winter loads This causes excessive ice build-up below the evaporator discharge. Unless constantly chopped away, it plugs the outside air inlet and causes water to leak into the building.

We want to design a system that will permit us to operate the evaporators and, at the same time, eliminate the above problems.—*RRL*

2 How can we provide expansion joints for pipe insulation?

My company, as industrial insulation contractors, has been faced with the problem of expansion on pipelines operating from 700 to 1000 F.

On runs of 50 ft or more expansion becomes a problem, particularly when the mechanical contractor uses expansion joints rather than expansion loops. We have tried several methods of expansion jointing our insulation. Sliding metal sleeves packed with insulation, both for single- and double-layer insulations, were not very successful.

Complicating the problem, the weatherproof jacket is firmly attached to the exterior of the pipe insulation, leaving no room for movement.

On the jobs we handle, steam piping runs of 1000 ft are not uncommon. Do *Power* readers have a solution to this thorny problem?—*RJA*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.

ALLIS-CHALMERS

Water Conditioning

ON THE JOB

Reporter finds solution to wide range of water problems

●Raw water is seldom suitable to meet specific requirements of the job. It usually needs some type of conditioning — best determined by a specialist. Here are typical examples of Allis-Chalmers water conditioning experience, equipment and chemicals in use.

Saved $22,000 First Year

Kansas—A chemical company plagued by high steam costs. Their boiler make-up water contained a high solids concentration, requiring a high blowdown rate.

After careful analysis of their problems, an Allis-Chalmers water conditioning engineer recommended Allis-Chalmers Anti-Foam. Use of this chemical resulted in increasing the solids concentration of the boiler water without carry-over. This, in turn, reduced the percentage of blowdown required.

Using A-C Anti-Foam, the company conservatively estimated first year savings of $22,000 in heat, water and chemicals.

* * *

Replacement of Condensate Return Lines Reduced to Practically Zero

Wisconsin—Here in one of the largest malt producing mills, several million pounds of steam are used daily for drying malt.

A special crew used to work all day every day doing nothing but replacing corroded condensate return lines. This, of course, was extremely costly.

Seven years ago, Allis-Chalmers water conditioning engineers were called in. Use of Allis-Chalmers No. 160 return line corrosion inhibitor was suggested.

Piping failures were reduced to the point where they only occur occasionally, and the maintenance crew has been assigned to other duties.

The Customer Is Always Right . . . Well, Most of the Time

East Coast — This plant had been using internal treatment of its boiler water. Chemical costs seemed excessive to management. After analyzing their own situation, they requested bids on a deionizer for treating makeup.

Instead of merely submitting a bid on the equipment specified, Allis-Chalmers engineers analyzed the water and the plant problem. This analysis showed that plant needs were such that a deionizer wasn't needed.

All that was needed was a de-alkalizer. Result: a savings of thousands of dollars.

* * *

The Case of the Dirty Dishes . . . or Don't Blame the Poor Dishwasher

Midwest — A harried plant cafeteria manager placed a frantic call to Allis-Chalmers water conditioning experts. Something was wrong. Glasses were spotty and plates had to be individually wiped off before they could be used. The grumbles were growing in the dining room . . . costs rising in the kitchen. His brand new $30,000 dishwasher wasn't getting the dishes clean, and the supplier of the dishwashing machine said the trouble was caused by the water.

The only trouble with that theory was that he had just installed a water softener the year before. The Allis-Chalmers water conditioning engineer examined the dishes coming out of the water and then asked to see the water softener. The problem was obviously hard water. The unit seemed to be in good working order and the tag indicated the softener had been recharged the previous day.

The maintenance man was called and asked to recharge the softener while an A-C engineer stood by. He went through all the steps—all but one, that is. He failed to close the bypass valve above the softener and practically none of the water went through the softener. It was then learned the operator was new and had not been properly trained.

Needless to say, the maintenance man is now an expert at operating the system, and everyone is pleased with the sparkling dishes.

Moral: A-C engineer's service covers the water front.

Expert Saves Steam for Drop Forge User

North Central — An Allis-Chalmers water conditioning engineer was called in by a manufacturer to supply water conditioning for makeup water. In checking the plant, here's what he found:

A large number of steam-operated drop forges are used by this company. The steam picked up oil from the pistons of the forge and was too contaminated for further use. It was dumped to waste.

He recommended installation of condensate oil removal filters. This was done and today practically all condensate is recovered. Makeup and water conditioning requirements are greatly reduced.

Problems Solved

For an answer to your industrial water problem, call the A-C office nearest you or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

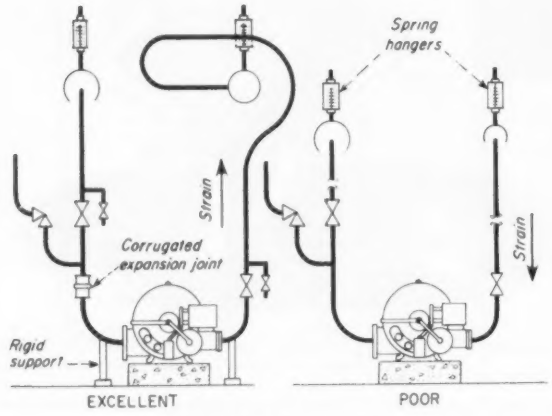
ALLIS-CHALMERS

WATER CONDITIONING • CHEMICALS, EQUIPMENT, SERVICE • FOR OVER 25 YEARS

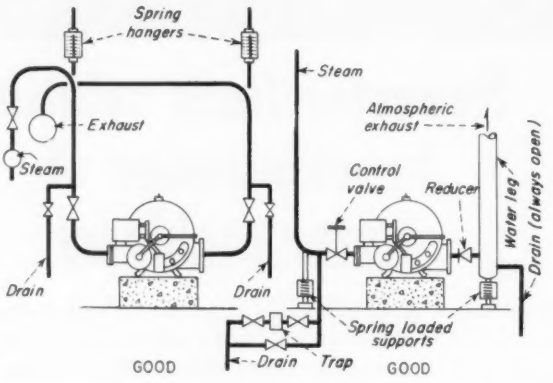
A-5237

ARGUMENTS . . . *let other readers know your views*

ALTHEA THORNTON, *Assistant Editor*



Antonacci's piping schemes



Livingston's piping schemes

Who's right here? How should turbine piping be supported?

I find it hard to follow D W Antonacci's suggestions for compensating for strains set up by thermal expansion in turbine piping (POWER, November 1956, p 132).

To begin with, thermal expansion and vibration in the turbine must be provided for, as well as expansion in the piping. Rigid supports under the pipes may prevent this.

In Antonacci's right sketch, above, the steam and exhaust leads apparently leave the headers on horizontal runs, then make 90-degree bends and drop down to the turbine. Spring hangers over the vertical runs, if properly selected and adjusted, should take the weight off turbine flanges at operating temperatures. But if conditions require supports under the elbows at lower ends of the pipes, the supports should be spring loaded, not rigid. Proper spring-loaded supports not only take piping weight off the turbine flanges, but also make allowance for some lateral movement.

Loop in Antonacci's left sketch is OK if it takes off from a header, but it should be supported by spring hangers from above. It might also need a vibration snubber.

The drains should be installed, but I don't understand purpose of the pipe on left side of the steam pipe. It looks like an atmospheric relief pipe.

My two sketches show piping on two recent jobs. My left sketch shows piping for two steam turbines direct connected to boiler-feed pumps. Exhaust header discharges to a deaerating feedwater heater.

My right sketch shows piping for a quick-starting turbine driving a boiler-feed pump that cuts in automatically if power supply to motor-driven pump fails.

Here, weight and layout required pipe support from below. Note spring-loaded supports under the piping.

H T LIVINGSTON, *Los Angeles, Calif.*

What readers say about holding two jobs

Follow canons of ethics. We presume the three ambitious engineers (December *Arguments*) are registered men. They should seek advice from their board of engineering examiners or from the consulting-engineering profession. Failure to consult their peers on a problem of practice indicates unfamiliarity with professional standards involving quality and completeness of work, professional liability, availability at the client's convenience, proper fee schedules and many other items of paramount interest to the client and our honorable profession.

They should contact the Consulting Engineers Council, 220 E 42nd St., New York 17, N. Y., for advice. The Council is the national organization of state and regional associations of consulting engineers. It represents specialists serving small segments of industry and the public, as well as those who serve the construction industry.

Consulting engineering needs men such as these, but on a full-time basis, and adhering to its standards.

C A KERSHAW, *Portland, Ore.*

Not under obligation. Unless the three ambitious engineers (December *Arguments*) are officers of the company or have signed an agreement to refrain from outside consulting work, they are not obligated to anyone. If they perform this work on their own time with their own resources, they are not conducting an unethical or unlawful practice. Their private life is their own business.

Since they have specialized skills and their services are in great demand, it may be to their advantage to leave their present employer and dedicate full time as consultants.

H B WAYNE, *Woodhaven, N. Y.*

Do a better selling job. The three engineers, (POWER, December, p 150) should do a better selling job to high-

(*Continued on page* 204)

WHAT TO LOOK FOR IN A HIGH PRESSURE-- HIGH TEMPERATURE STEAM TRAP....

High pressure—high temperature service is no place to cut corners, no place to to take chances. Here are some things to think about in specifying steam traps:

1. Experience—Since right after World War One, Armstrong trap development has kept pace with the trend to higher and higher pressures and temperatures. These traps are the most widely used of any in leading power plants throughout the world at pressures up to 2400 psig—there is no finer endorsement.

2. Design—The simple, dependable Armstrong inverted bucket mechanism provides the closest thing possible to 100% assurance that the trap will not fail to open for condensate and close for steam. Extra heavy forgings provide large safety margins.

3. Materials—see list at left.

4. Price—Armstrong forged steel trap list prices range from $95 to over $1000. The No. 515 shown above is rated for 1500 psig at 900°F and for 2000 psig at 600°F. It lists at $500. Armstrong prices are moderate for what you get because of high production. *There is no compromise made at the expense of safety, quality and low maintenance.*

Want more facts?—Call your local Armstrong Representative or write: Armstrong Machine Works, 8123 Maple Street, Three Rivers, Michigan.

Do you have Catalog J?—This 44-page Steam Trap Book is free on request.

ARMSTRONG MACHINE WORKS
8123 Maple Street • Three Rivers, Michigan

LIST OF MATERIALS
ARMSTRONG FORGED STEEL TRAPS

Part	Material
CAP AND BODY FORGINGS Up to 600 psi, 750° Up to 900 psi, 900° Up to 2500 psi, above 900°	 1030 carbon steel ASTM Spec. F-1 carbon moly steel ASTM Spec. F-5 chrome moly steel
VALVE AND SEAT	Type 440 chrome steel, heat treated, standard. Stellite available.
LEVER MECHANISM	Stainless steel
BUCKET	Stainless steel
BOLTS	Class C high tensile, high temperature bolting material—125,000 min. tensile.
NUTS	Hex, semi-finish, heat treated for high pressure, high temperature service.
GASKET	Compressed graphited asbestos
INLET TUBE	Wrought iron

STEAM TRAPS FOR EVERY REQUIREMENT — APPLICATION ENGINEERED

ARMSTRONG STEAM TRAPS

HOW TO

Solvent weld plastic pipe

► NOW ALL YOU NEED to weld piping is some solvent and a paint brush. Three-step procedure shown gives you a sure, tight joint that is at handling strength in a few minutes. Besides ease of welding, this Butyrate pipe weighs 90% less than metal pipe. It can be hack sawed to any length in a few minutes. These features help to cut your transportation and labor costs to the bone.

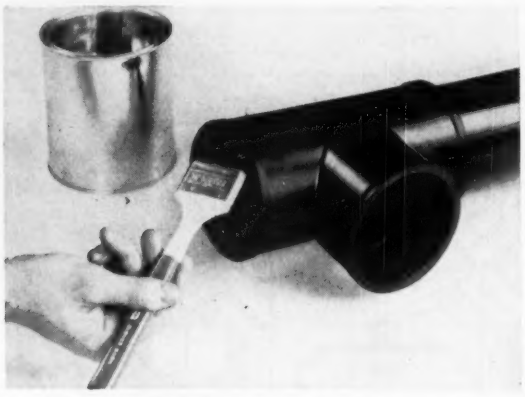
One big advantage is that it does away with expensive threading or welding needed for metal piping. Manufacturer says it's flexible enough to allow for bending to fit ditch contours. Piping comes in either black or clear, with a complete line of fittings for joining sections of plastic to plastic, or plastic to metal pipe.

To join, brush a strip of solvent on the pipe end to be fitted. Then brush solvent on the inside of fitting as shown. Third and last step: Insert the pipe end with a twist motion until it reaches the stop inside the fitting. This twisting motion helps expel air bubbles in the solvent, thus makes a much better joint.

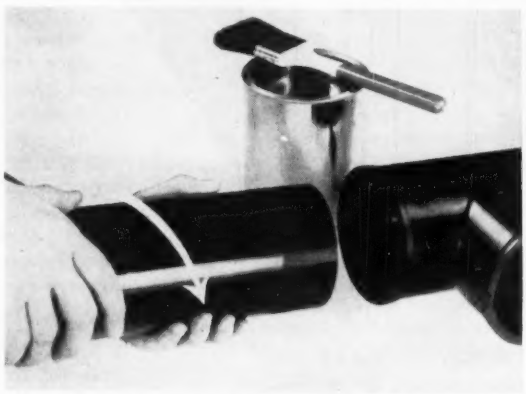
Uses. This plastic piping is especially adaptable to salt-water disposal, vent lines, renewal liners for old gas-service lines, natural-gas lines, transportation of corrosive liquids and gases, refinery discharge and sour crude gathering.

Courtesy, Continental Can Co, New York, N. Y.

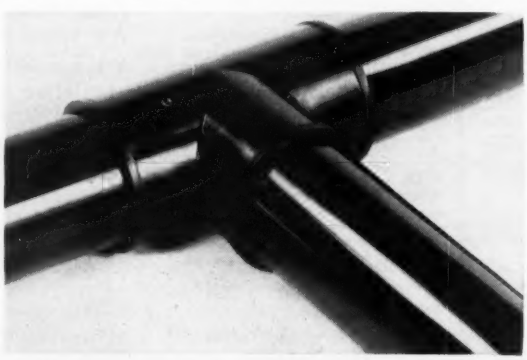
1 Brush a strip of solvent onto the end of the pipe to be fitted. Solvent comes in a handy sized metal container



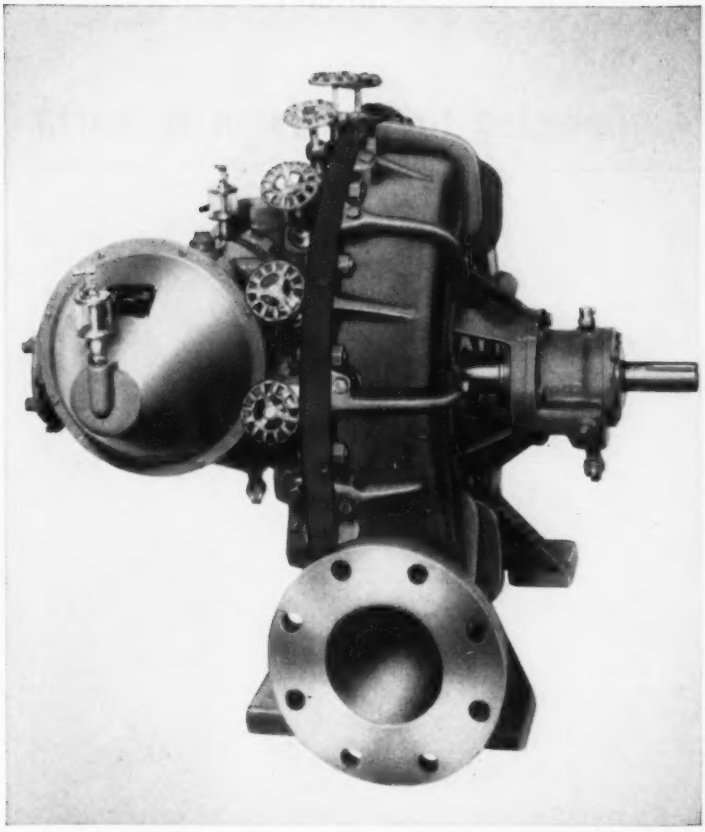
2 Next, brush thinner inside the fitting as shown. Apply just enough of this thin liquid to cover mating surface



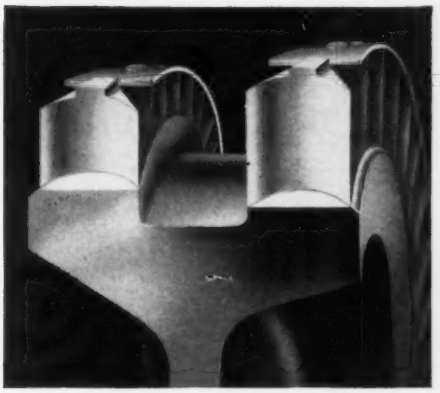
3 Now insert the pipe end with a steady twisting motion until it is seated firmly against stop inside the fitting



4 Within a few minutes, the tight joint is firm enough for handling the assembly without danger of disturbing joint



This is the reliable Coppus Turbine furnished with either type of wheel



Wide bucket "L" type wheel

Regular type wheel

Top performance in all COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
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- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, ***make turbine dollars go farther.*** Send for Bulletin 135 on Coppus Turbines.

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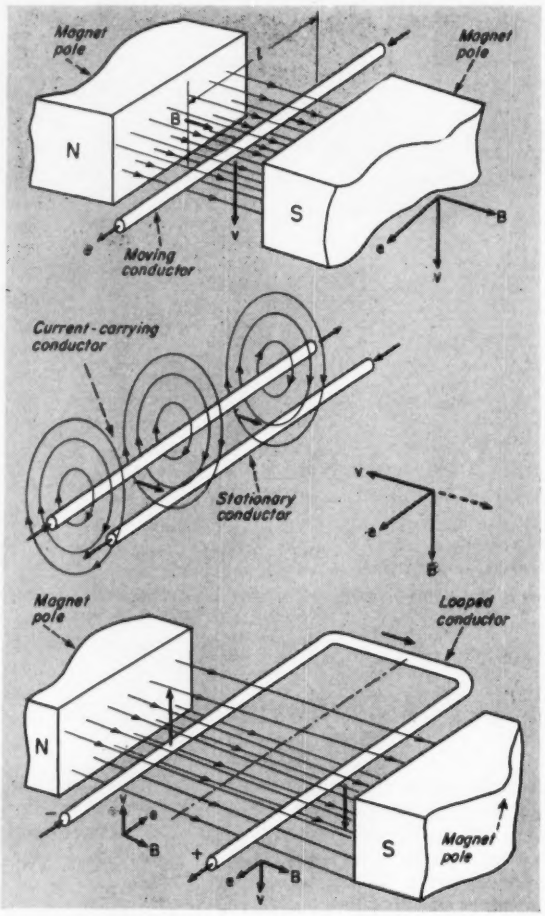
BASICS . . . *bringing engineering theory down to earth*

NORMAN PEACH, *Assistant Editor*

Electricity: 8

How an emf is generated



ELECTROMAGNETIC INDUCTION occurs when the conductor cuts flux or when the moving flux cuts a stationary conductor

► WHEN A CONDUCTOR is moved through a magnetic field in such a way that it cuts across magnetic lines of force an electromotive force (emf) develops in the conductor. If the conductor is part of a closed circuit, current will flow in the conductor. This method of generating an emf is called *electromagnetic induction*. It's the most practical way to generate large amounts of electric power.

A single conductor, moved through a uniform magnetic field at right angles to lines of force, has an emf induced in it in the manner shown in top sketch. Here B represents flux density (lines of force per unit area) of the uniform field. Direction of the flux is from N to S, that is, to the right. The conductor moves downward at a uniform velocity v. The induced emf e is in a direction at right angles to B and v (from right to left). The *right-hand rule* will help you remember this relationship: With your thumb, forefinger and middle finger at right angles to each other, let your thumb point in direction of motion and forefinger in direction of flux. Then your middle finger points in direction of the emf.

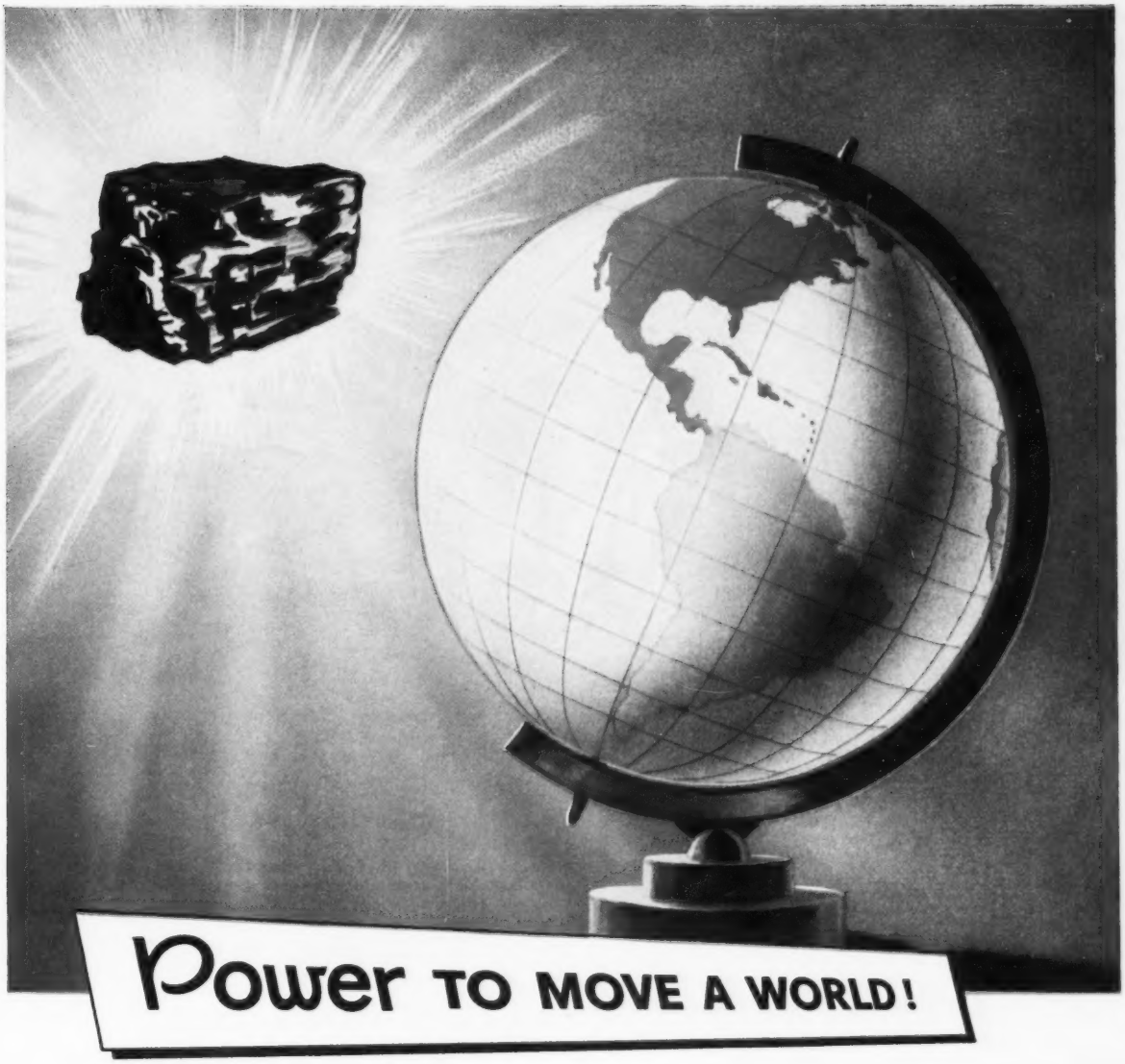
Magnitude of emf is found by formula: $e = Blv \times 10^{-8}$, where B is flux density in lines per square centimeter, l is length of conductor in magnetic field in centimeters, v is velocity in centimeters per second, $10^{-8} = 1/100{,}000{,}000$. It's obvious that a strong field is required to induce commercial voltages. Between 6000 and 8000 lines per square centimeter is flux density commonly used in generators.

Necessary conditions for generating an emf in a conductor are: (1) Movement of conductor relative to flux (2) Lines of flux must be cut. If conductor stands still in constant magnetic field, no emf is induced, no matter how strong the field may be. If conductor is moved *parallel* to flux, no emf is induced. If conductor cuts flux at an angle, some emf is induced, with maximum emf induced when cutting flux at right angles.

It's relative motion between conductor and flux that counts. If conductor is stationary and field moves so that its flux cuts conductor, an emf is induced. This is shown in center sketch where current-carrying conductor is moved to *right*, which is equivalent to moving the stationary conductor to *left*. Direction of induced emf is shown by arrows. It's not necessary for either conductor to move if flux can be made to move between them. When there is zero current in conductor at left, there is no flux. As current increases, rings of flux extend outward from center. They cut across conductor at right, inducing an emf in the direction shown. When current reaches maximum and remains steady, the flux does not move and no emf is induced. However, if current is decreased, the collapsing field again cuts the right-hand conductor, but this time in the opposite direction. The emf induced is, therefore, in the opposite direction. This type of electromagnetic induction is important. We'll take it up in a later *Basics*.

A coil or looped conductor is shown in bottom sketch. Here both sides of loop cut flux as loop is rotated about its center. The emfs add to give double the emf of single conductor. The emf can be further increased by looping the conductor around again, producing a coil of two turns. This coil principle is important for both ac and dc generators.

Next month's Basics: Direct-current generators.



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"Hi, Pierre," yelled Charlie Stenke, the welding boss. "Why don't you let me weld wings on that shovel so she can fly across the river?"

Marmy's flying shovel

► BEDLAM'S Bent Propeller Bar on the New York waterfront was busting at the seams with activity when I dropped in on New Year's eve. Bedlam had just given two rowdy characters the bum's rush by gently kicking them the hell out the front door.

Inside, an assortment of uniformed mariners from nearby ships, local stationary engineers and water-front characters were drowning the old year in an assortment of galvanizing solutions. Sandpaper Gin, Dragon's Blood, Block and Tackle, and other interesting drinks were being rushed to the thirsty cash customers who crowded the tables and bar. Everyone was yak-yaking, singing, drinking and smoking.

Only Marmaduke Surfaceblow—marine engineer, master mechanic, stationary engineer and at present the world's best known and most unusual consulting engineer—was quiet. His 6-ft 4-in. frame leaned against the crowded bar while he gazed intently at the bottle of Sandpaper Gin before him. His battered gray bowler was perched at a jaunty angle atop his silver dome. The foxy old consultant was deep in thought, no doubt wrestling with the many complex engineering problems that baffle science.

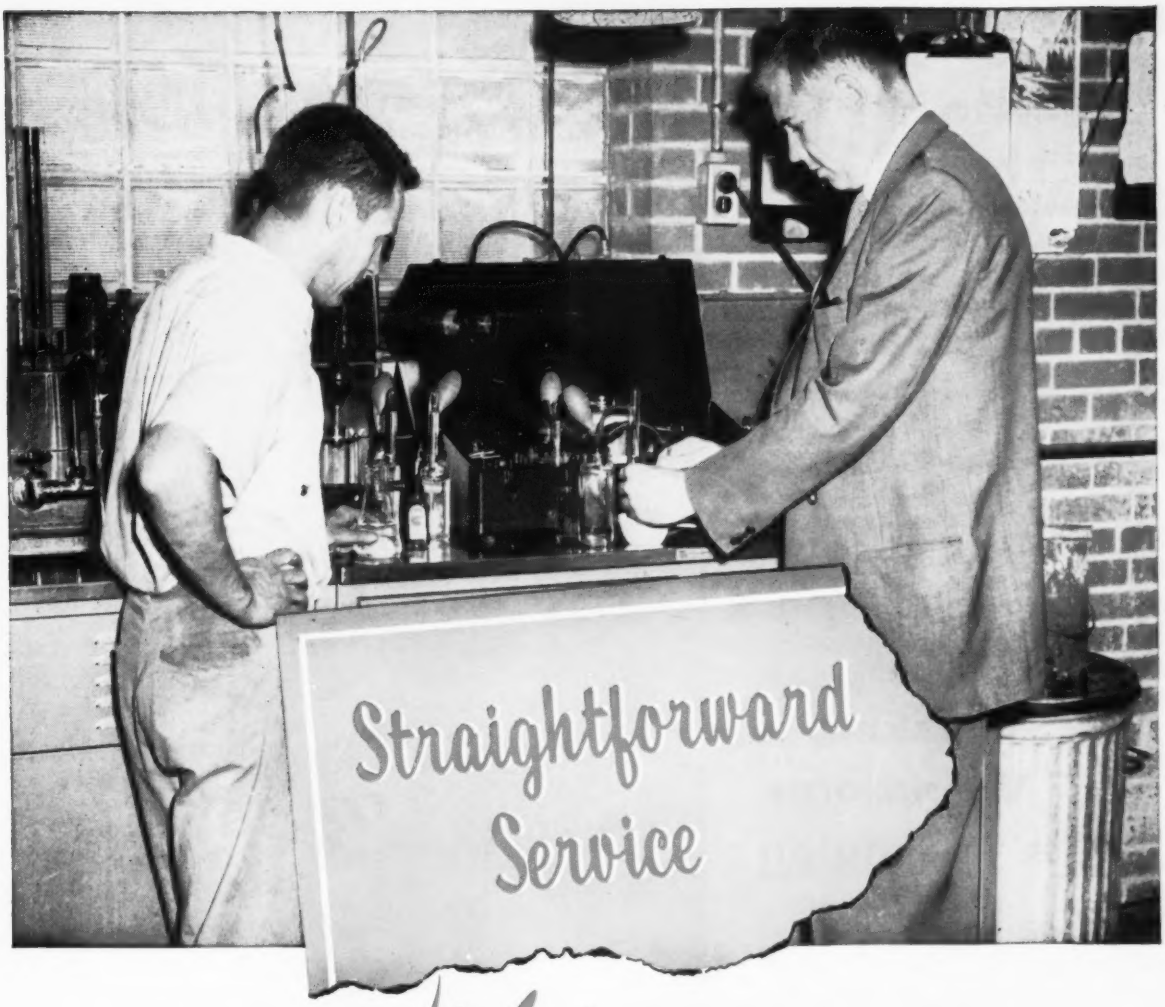
Suddenly Marmy grabbed his bottle with his huge right fist, worked up a 26-in. vacuum on his ballasting pump and, without coming up for air, stripped the bottle down to the last drop. Then he gave his bowler a starboard list and roared defiantly in his foghorn voice.

"BILGEWATER on 1956, she's dead. I'll tell you throttle pullers how I got a 40,000-lb power shovel across a deep river and all I used was my head."

That did it. The noisy chatter died instantly to a few decibels. Here was the voice of experience—past, present and future—about to reveal some amazing facts.

No prophet of old was looked upon with such respect and devotion by the multitudes as this colossus of an engineer. Nor were any before him looked upon through as many bleary, bloodshot eyes as was Marmy on this New Year's eve. Satisfied that he had the undivided attention of all he surveyed, Marmy hooked his huge fists into the armpits of his checkered vest, backed against the bar, then blasted away in his steamboat-whistle voice.

"Back in 1934 I was rigger boss at a new plant up in Lamartine, Ontario. We had a lot of construction work to do and I had a hard-working gang. Being off the (*Continued on page* 188)



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Nalco WATER TECHS

A paper on "A Laboratory Method for the Study of Steam Condensate Corrosion Inhibitors," presented at the 8th Annual Conference, National Association of Corrosion Engineers, has been reprinted by Nalco for distribution to men interested in this problem. Your copy will be sent free upon request.

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JENKINS Fig. 106-A

Renewable Composition Disc
BRONZE GLOBE VALVE
150 lbs. Steam 300 lbs. O.W.G.
1/8 in. to 3 in.

Making a Workhorse a Champion

Take a Fig. 106-A apart. It's easy to see the reason why it's the "champion" of disc-equipped Bronze Globes. Every part, from heatproof handwheel to pipe ends, reflects the design and construction skill of generations of Jenkins Valve specialists.

Fig. 106-A not only looks better — it proves out better in performance. In any comparision, its long-life, low-upkeep record has always set the standard. That is the true measure of valve cost — and it is the reason why industry's shrewdest buyers will settle for nothing less than Fig. 106-A quality.

the FIRST
Renewable Composition Disc Globe Valve

Industry's all-time champion for long-range economy

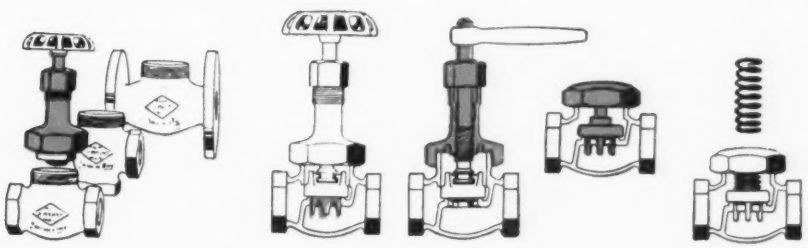
Work horse of industry's pipelines is the renewable composition disc Bronze Globe.

Jenkins valve specialists have always taken a special view of this type of valve. It dates way back to the time when Jenkins introduced the *first* renewable composition disc Bronze Globe. In fact, Jenkins is still the only manufacturer of both valves *and* discs.

Jenkins engineers reasoned that the valve that has most of the work to do should have a liberal extra measure of dependability. The result is Fig. 106-A. It has all the rugged endurance of a work horse. But it also has the fine form, the lasting sensitivity of control — all the characteristic features of a champion.

That's why it is the leading choice of valve-wise buyers throughout industry. Test the Jenkins 106-A "family" on your toughest services. See why they are your best buy for lasting valve economy.

Ask your Jenkins Distributor for full information, or write: Jenkins Bros., 100 Park Ave., New York 17, N. Y.



One Good Valve Becomes Another . . .

The Fig. 106-A "family", with interchangeable parts, provides patterns to meet a large majority of the valve needs for most industrial and commercial piping systems.

Trimming is interchangeable in screwed or flanged Globe, screwed Angle bodies. Combinations provide valves for Quick-opening or Throttling service, Lift Checks and Spring-loaded Checks.

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Reader service section

Start with these quick samples...

Where there's smoke . . .

there's something cooking. In the last few months, a number of releases have crossed our desk on the subject of engineering unions; so many, in fact, that we decided to investigate. The results of our study are wrapped up in a feature story on this month's news page. We think it's one you'll want to read. Turn now to . . .

Reports from the field, p 156

Curiosity killed the cat . . .

but it's food and drink for an engineer who wants to get to the top. He *has* to be interested in all the new developments in his field. Trouble is there's never enough time for all the reading he has to do. With this in mind, Power offers, each month, a digest of the latest technical papers complete with directions for getting the full report.

Technical briefs, p 158

A new broom . . .

may sweep clean but it'll never do the trick in today's plants. As industry grows more complex, plant maintenance men seek bigger and better tools. For this reason, we've included a full page on maintenance equipment and materials in our new-equipment section. Three additional pages are devoted to the units that power and control today's plants.

Plant equipment news, p 162

Whadda ya read . . .

in the way of trade bulletins? Whatever it is, chances are we've listed it and you can get it—free. All you have to do is scan our columns, make your choices, print them on the post cards we provide and mail. We do the rest. In a short while, you'll have the reading matter you want. You can't make a better investment than that.

Free literature, p 171

The vintage years . . .

are the years from 65 on when we reap the fruits of our labors and experience. But many people fail to take advantage of these years. Taken out of harness, they lose interest in life. An increasing number of companies, realizing this, have set up orientation programs for their senior employees to prepare them for retirement. For their story . . .

George Edwards, p 174

For other timely ideas, see following service pages ▶

How it Works!

Only new Sarco TD steam trap uses kinetic energy of steam to close valve

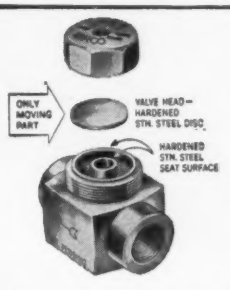
GAS MANTLES have been replaced by electric lights, steam locomotives by diesels, propeller planes by jets.

Now, the use of the kinetic energy of steam principle gives us a modern type of steam trap.

The Sarco TD obsoletes all other types for most 10 to 600 psi installations. For example, it operates without a valve closing device—no bucket, float, bellows, pins, levers or gaskets.

Glance below and you'll agree that no other steam trap is even similar to the Sarco TD!

For a trial installation—write today.



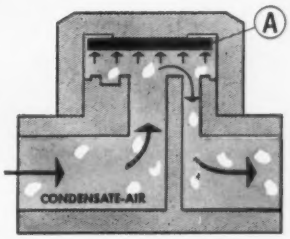
Only 3 parts...all stainless steel

Sizes ⅜ to 1"—each body is as small as a tee fitting! Capacity is determined not by a bulky body but by the effective orifice, valve action, pressure drop and condensate temperature.

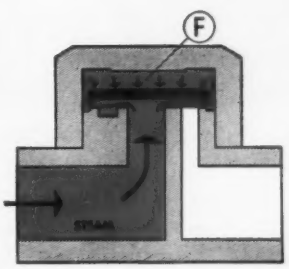
Many Advantages

1. *Practically no maintenance*—no valve mechanism, no narrow channels. Trouble-free simple design. Only 3 parts—all stainless steel.
2. *One trap for all pressures*—self-adjusting. One large capacity seat for 600 psi as for 10 psi. No changes or adjustments.
3. *Operates equally well on all loads*—on heavy, light or no condensate load. No prime to lose. No adjustments.
4. *No steam leak required*—to operate the Sarco TD. Closes tight against steam.
5. *Discharges at steam temperature and vents air* and air-steam mixtures at start-up and during operation.
6. *Freeze-proof*—when installed with outlet down, free to drain.

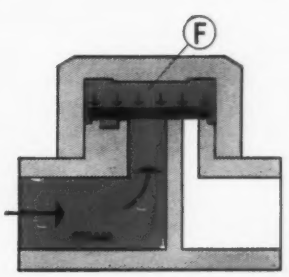
Only Sarco TD Thermodynamic Steam Trap Uses This Unique Operating Principle Which Permits Trouble-Free TD Design



1. Inlet pressure raises disc "A" from seat... immediate discharge of air and condensate at steam temperature.



2. Steam follows the condensate and the high velocity jet across the bottom of disc "A" creates a low pressure area (Bernoulli effect)...the jet is deflected into chamber "F" where it builds up pressure by recompression and this pressure acts on the top of the disc "A"...



3. Pressure in chamber "F", acting on full top area of disc "A", exceeds force of incoming steam and low pressure area under the disc...and immediately forces it down, closing the inlet. As condensation decreases the pressure in chamber "F", the disc rises and steps 1 or 2 repeat.

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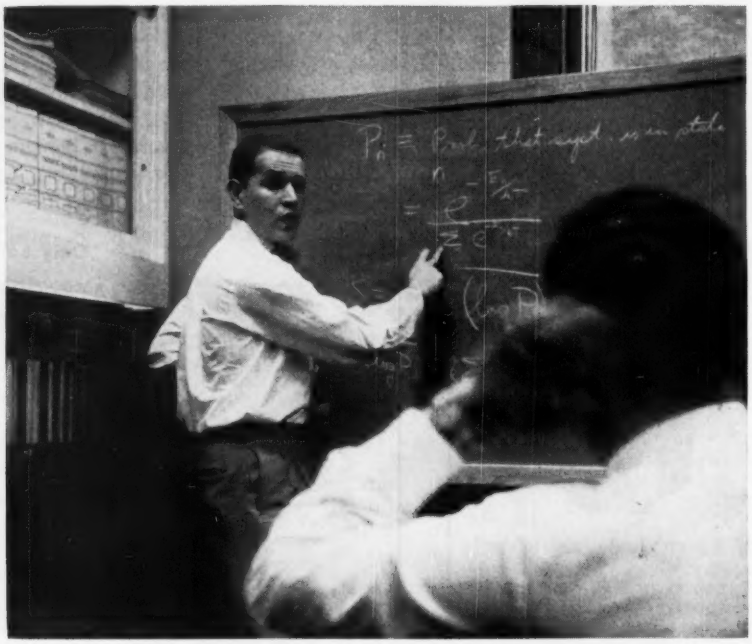
REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 226

With labor in the bag...



unionists eye engineers, other white-collar workers

Engineer discontent boosts AFL-CIO hopes

► IN THE EARLY part of February, the AFL-CIO gave the go-ahead for a campaign to organize white-collar workers. U.S. engineers, numbering 500,000, were pegged as a prime target.

It was a move which added more fuel to an already fiery debate raging in engineering circles. Professional engineering societies are solidly opposed to any attempts at union organization. The engineers themselves are divided on the question of which way to jump.

Past efforts to organize this group have been discounted almost without comment. Why all the shouting now? The answer involves a curious paradox.

Today's engineer feels that he is a sort of man without a country. Professional training lifts him above the rank and file of labor, but mass employment, in many instances, bars him from the ranks of management.

As the man between, the engineer feels that he is losing his professional identity.

In the past, when industry was less complex, engineers dealt directly with management; they felt themselves part of the management team. Under this close-knit set-up, the engineer relied on personal contact to secure recognition of merit.

But with the growth of business, the

(*Continued on page* 226)

Power Lines

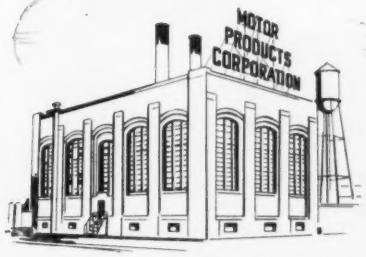
Mongoose and man pitted their brains on a cable-pulling operation on the Jersey Turnpike last month. For outcome, see story on page 128.

Foreign sources report the first Czech atomic (electric power) plant will be started in Slovakia this year. Capacity will be 150,000 kw.

Miniature nuclear-powered battery, capable of continuous electrical power for 5 years, is baby of Elgin and Walter Kidde Nuclear Labs.

Mexican queries on price of 30,000-kw nuclear power plant are mystifying observers who know that AEC and Mexico have no agreement.

Ingersoll-Rand steam-driven compressor pays for itself in three years



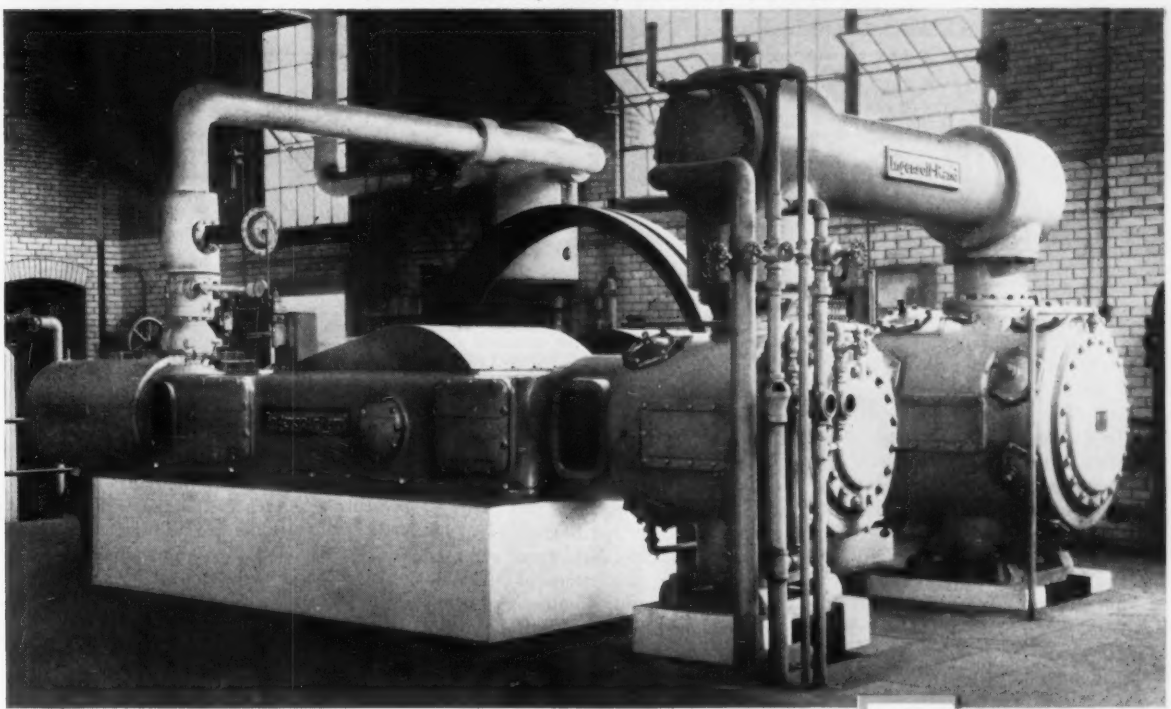
When Motor Products Corporation modernized their main Detroit plant, they installed an Ingersoll-Rand XPV steam-driven compressor at the advice of their consulting engineers, Boddy, Benjamin and Woodhouse, Inc. This modern compressor improved plant steam balance by utilizing available steam.

The exhaust steam from the compressors is used for building heating and feedwater heating. At full load, this compressor saves $26,000 a year in power costs over the old electric-driven unit it replaced. This saving will repay the original cost of the compressor in only three years.

Not every compressor can save this much in a single installation, but by careful selection, application and control, Ingersoll-Rand compressors can be adapted to give the utmost economy under any given set of conditions. Your I-R representative will help you find the compressor and conditions that give the most air power for your investment.

Ingersoll-Rand steam-driven compressors are available in sizes from 10 to 2500 horsepower. Other types are available in sizes from ½ to 6000 horsepower, pressures to 35,000 psi and vacuums. All units are built to the exacting Ingersoll-Rand standards of durability and economy of operation.

This 1950 cfm XPV steam-driven compressor furnishes 100-psi air at the Motor Products Corporation plant in Detroit, Michigan.



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Estimated costs and capacities
Proposed nuclear plant at Indian Point, N. Y.

	Case 1: Saturated steam	Case 2: Superheated steam
Steam pressure at boiler, psig	420	420
Steam pressure at turbine inlet, psia	405	355
Steam temperature at turbine inlet, F	446	1000
Gross electrical output, kw	140,000	236,000
Turbine plant heat rate, Btu/kwhr	12,900	10,700
Total plant cost	$45,000,000	$55,000,000
Total plant cost per kw	$322	$233

Incremental data on superheating

Increased capacity due to superheating, kw	96,000
Increased cost due to superheating	$10,000,000
Cost/kw of increased capacity resulting from superheating	$104
Heat rate of increased capacity, Btu/kwhr	7700
Cost/kw of increased capacity, adjusted for better heat rate, vs 9500 Btu/kwhr heat rate of best conventional station	$74

Estimated power production costs
Indian Point nuclear power plant

Gross reactor capacity, mw, heat	500
Gross electric capacity, mw: reactor	140
superheater	96
Total	236
Net electric capacity, mw: reactor	130
superheater	89
Total	219
Annual net production, mwhr (80% load factor)	
reactor	910,000
superheater	623,000
Total	1,533,000

Annual costs	Total	Per kwhr
Fixed charges ($55,000,000 @ 13.5%)	$7,430,000	0.485¢
Fuel (nuclear, oil)	4,650,000	0.303
Operation and maintenance	1,500,000	0.100
Total	$13,580,000	0.888¢

These nuclear plants start operating in 1960

The Consolidated Edison Indian Point nuclear power plant. *By G R Milne, Consolidated Edison Co and F R Ward, The Babcock & Wilcox Co.*

The Consolidated Edison Co of New York plans to construct a nuclear steam-electric generating station on the Hudson River about 24 miles north of New York City. Reactor will be a pressurized water, converter type and will be the first commercial unit to use thorium as the fertile material to supplement the base fuel U-235.

Heat from the reactor would produce 140,000 kw of electric energy if it were not superheated. But, the saturated steam leaving the reactor will be superheated in separate oil-fired units, resulting in a total capacity of 236,000 kw. This will give substantial decreases in both cost of plant per unit of capacity and in plant heat rate. Costs are given for both of these arrangements. The reactor system and its component parts are described, and in addition those features of the remainder of the plant are covered which are important to the operation of the reactor.

The company expects that the core will be installed in the reactor in the fall of 1959, initial critical operation will begin in December 1959, and full power operation will be attained by May, 1960. *ASME paper No. 56-A-167.*

The Yankee Atomic Electric plant. *By G A Reed, Yankee Atomic Electric Co, R J Creagan, Westinghouse Electric Corp and W C Woodman, Stone & Webster Engineering Corp.*

The Yankee Atomic Electric plant is to be a pressurized light-water reactor specifically for production of 134-mw net electrical power. No other chemical or radiological functions will be performed at the facility, which is located in Rowe, Mass.

The reactor type is well-known, and its chances for operating success are good in consideration of data accumulated under AEC and Naval programs.

Previous pressurized-water reactor plants have generally stressed particular application or full-time reliability as major objectives. The major objective for the Yankee plant is to make the pressurized-water reactor nearly commercially competitive with conventional steam plants, without sacrificing any of the inherent safety of this reactor type.

Construction is scheduled to be near completion by May 1960; reactor is to go critical in mid-1960. This paper presents a reference design for the reactor. It is not the final design, which will be specified at completion of the research and development program. *ASME paper No. 56-A-166.*

The Dresden nuclear power station. *By J R Wolcott, V A Elliott, E P Peabody, G M Roy, J L Schanz, G Sege, General Electric Co.*

Purpose of this paper is to present a design description of the Dresden nuclear power station, a 180,000-kw all-nuclear unit being designed and built by General Electric Co for ownership by Commonwealth Edison Co. It will be located 50 miles southwest of Chi-

Directions for ordering papers on page 218

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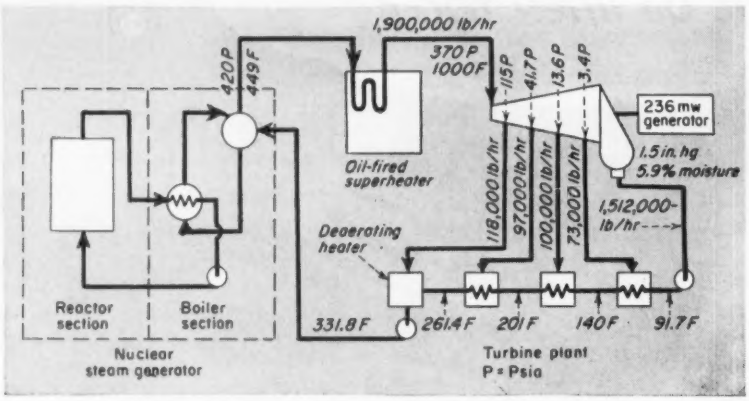
Begins on page 158



HEAT BALANCE DIAGRAM for Con Edison's Indian Point nuclear plant. Heat rate for steam cycle exclusive of reactor efficiency is 10,700 Btu per net kwhr produced

cago at the confluence of the Des Plaines and Kanakee Rivers.

Plant is to be in service by 1960. Site construction is scheduled to start in the early spring of 1957.

The fundamental design objective is to produce a safe, reliable, economical station that meets the terms of the contract and incorporates as many additional plus features as possible. Conditions that will satisfy project objectives are: 180,000-kw net electrical output at 85% power factor and 75-F condenser cooling water; capability for operation at 60% capacity factor; total energy costs approximately comparable to those of the most efficient plants in the Commonwealth Edison system.

The primary nuclear fuel is to be uranium oxide, although modifications of core design and substitution of new fuels after startup will be provided for. Maximums for critical reactor parameters are as follows: (1) 300,000 Btu per hour per square foot maximum fuel element heat flux (2) 3000-F uranium oxide fuel temperature (3) 2.5% reactivity compensated by steam voids in the reactor moderator. *ASME paper No. 56-A-169.*

Enrico Fermi atomic power plant. *By J F Anderson, Power Reactor Development Co, W N McDaniel, Atomic Power Development Associates, Inc, C M Heidel, The Detroit Edison Co.*

Atomic energy will be converted to electricity at this plant through the use of a liquid-metal-cooled fast-neutron breeder reactor. This is a cooperative project between private industry and the federal government.

This type reactor offers the attractive possibility of using low-cost nuclear fuel in the form of abundantly occurring U-238 and thorium. Use of liquid sodium as the reactor coolant permits high-temperature operation without encountering, at the same time, high coolant-system pressures. Use of heat of fission at high thermal efficiency, therefore, can be attained.

The reactor core will consist of a uranium-molybdenum alloy, enriched to approximately 25% with U-235.

The Power Reactor Development Co will initially supply Detroit Edison with 1,015,000 lb steam per hr at 600 psia, 755 F. Detroit Edison will return feedwater at 400 F. After two years, PRDC will provide 1,470,000 lb steam per hr at 900 psia, 820 F. Detroit Edison must return feedwater for this flow condition at 430 F.

The reactor and associated steam-electric generating plant will be built on a site about 30 miles southwest of Detroit. By December 1960, the turbine-generator will be in place and ready for full power commercial operation. *ASME paper No. 56-A-168.*

The PAR homogeneous reactor project. *By W E Johnson and D H Fax, Westinghouse Electric Corp and S C Townsend, Pennsylvania Power & Light Co.*

The Pennsylvania Advanced Reactor project is a major development effort jointly sponsored by Westinghouse Electric Corp and the Pennsylvania Power and Light Co. Its function is to carry out the experimental and analytical studies leading to the design of an aqueous homogeneous reactor plant having an electrical output of 150,000 kw. This plant is to operate on the PP&L system in eastern Pennsylvania and is planned for operation in 1962.

The history, organization and development program of the project are described. Advantages of the single region thorium breeder type of aqueous homogeneous reactor are set forth and a progress report is given on the work being done to solve the problems yet facing it. *ASME paper No. 56-A-170.*

Proposed 75,000-kw sodium graphite reactor for the Consumers Public Power District of Nebraska. *By F C Gronemeyer, R C Gerber, H M Hagaman, H B Holz, H A Ross-Clunis, E F Weisner, North American Aviation, Inc.*

The Sodium Graphite Reactor (SGR) is a low-pressure high-temperature liquid-metal-cooled system using solid fuel and solid moderator. The SGR has both immediate technical feasibility and potential for future improvement. Among its more important features are:

(1) A high coolant temperature (925 F at present) is possible without requiring pressurization of the reactor heat extraction system.

(2) The reactor can be adapted to a variety of fuel elements and operating conditions. Slightly enriched uranium or a thorium-uranium fuel may be used.

(3) There are no chemical incompatibilities in the fuel element, coolant, structure combination.

(4) The absence of releasable potential energy from pressurization or chemical reactions increases the inherent safety of this reactor system and permits the plant configuration to be easily arranged to contain radioactivity under all circumstances.

The plant described in this paper follows the general specification of the 75,000 net electrical kw power plant which has been proposed by Atomics International Div of North American Aviation, Inc to the Consumers Public Power District of Nebraska. The paper describes only the steam generating facility and the sodium-reactor heat source. *ASME paper No. 56-A-171.*

Hydro

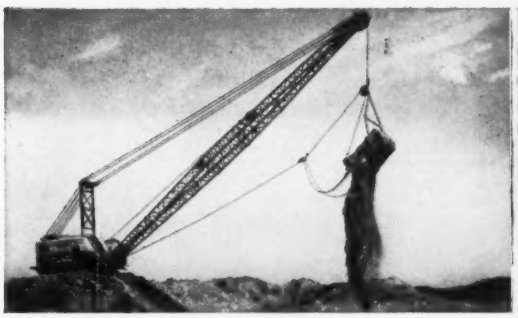
Thermal plants for firming up hydro. *By V W Ruskin, B C Engineering Co, Ltd.*

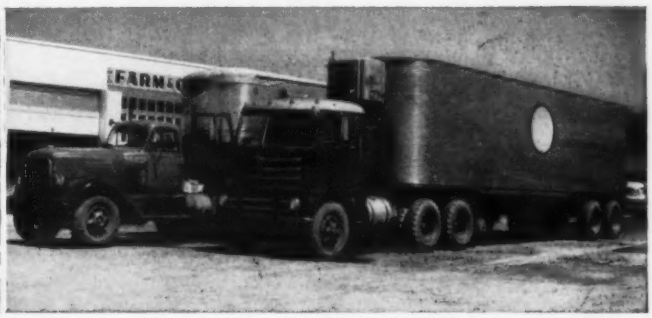
A hydroelectric system must be engineered to carry the anticipated firm peak and energy loads even under adverse water conditions. When condi-

(*Continued on page* 207)

Directions for ordering papers on page 218

For every type of diesel operation—



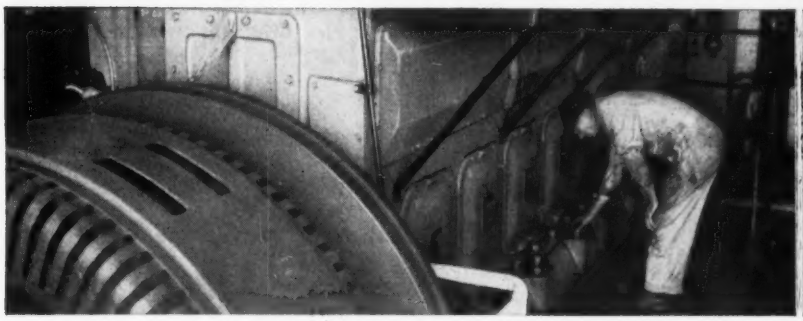


FOR MECHANIZED DIESELS, there's a Cities Service diesel oil for every operating condition. Most widely used is Cities Service C-300 Motor Oil, which has improved performance and lowered maintenance costs for a host of truckers, quarry operators, and mining men. Shovel above logged 16,280 hours with no repairs, no increase in oil consumption. A Cities Service Lubrication Engineer will gladly show how you can achieve similar results.

the right track to greater profits

FOR RAILROAD DIESELS, Cities Service now offers a brand new oil . . . Pacemaker RD-80. Proven superior by over 50 million miles of operation on major railroads, new Pacemaker RD-80 reduces oil consumption up to 10%, cuts engine deposits 200% better than previous oils. Also gives superior protection of ring belt area. According to a leading engine builder, its oxidation stability is "the best of any oil tested."

is Cities Service Diesel Oil!



FOR STATIONARY DIESELS, Cities Service C-300 Lube Oil has won high praise from numerous users. Example: Paulding Light and Water reports 16,587,402 H.P. hrs. without oil change; gets 23,205 BHP hrs. per gallon consumed! For more information, write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

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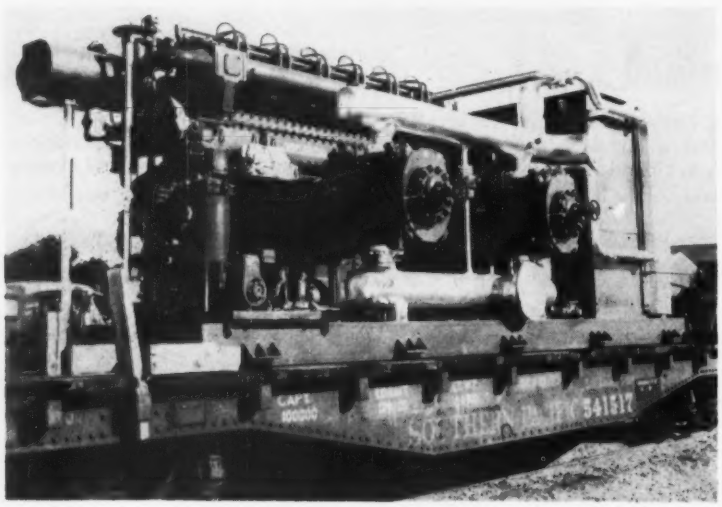
PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



Turbocharging for 330-880 hp gas-engine compressor

301 • After five years of research and field tests, engineers have produced a turbocharged gas-engine compressor known as the *SLHC*. Available in medium horsepower range (330-880 hp), this engine compressor is said to be the only gas-engine compressor in its class size that has been turbocharged.

Turbocharging is a key feature of unit. Turbocharger, deriving all its energy from otherwise wasted exhaust gas, compresses ambient intake air to an elevated pressure for cylinder charging. This results in greater power per unit space and greater portability, as well as economy for any certain size. All these advantages are said to apply to permanent installations as well.

Unit is designed for gas gathering, pipeline and distribution service; in natural gasoline plants; for pressure maintenance in oil fields; for oil refinery operations such as vapor recovery, recycling and stabilization of gases; for refrigeration systems. Request complete details from the manufacturer.

Worthington Corporation, 426 Worthington Ave, Harrison, N. J.

Compressed air-gas trap features system-power action

302 • Compressed-air and gas trap discharges condensate from compressed air or gas lines by a combination of magnetic, pneumatic and fully automatic action.

Operation of trap is said to be simple. As condensate in trap rises, float does not rise but is held firmly in place by magnet mounted on the pivot arm. When the force build-up of the condensate working on the float overcomes the magnetic attraction, float snaps open the pilot valve.

Air enters the pilot valve, flows down the stem, and up under the piston, forcing the piston assembly upward. As piston assembly moves upward, it opens main discharge valve. Condensate is forced into main discharge valve by system pressure and out into the discharge outlet.

When sufficient condensate has been discharged, float drops, and magnetic attraction of magnet to float arm causes the snap closing of pilot valve. Air supply to piston is cut off; air in piston chamber bleeds out; piston returns to original position, closing main discharge valve. Pressure range of trap is 10 to 200 psig. Request details.

Hankison Corporation, 951 Banksville Rd, Pittsburgh 16, Pa.

Line-operated pH meter

303 • Meter is designed to permit use by operators with limited training, while still maintaining an accuracy of 0.1 pH unit.

Unit can be furnished either with individual glass and calomel electrodes or with a probe electrode; that is, a combination of glass and calomel electrodes.

According to manufacturer, it has the simplest possible construction.

Photovolt Corporation
95 Madison Ave, New York 16, N.Y.

Maximum-minimum thermometers

304 • Stainless-steel stem thermometers feature two ancillary indicators. These can be manually set against the high and low sides of the indicating pointer by means of a knob located in the center of the glass window. Maximum-minimum hands then move up and down scale. They remain at the extreme temperature reached until manually reset.

One reading of the present temperature of the thermometer gives both the maximum and minimum temperatures since the last reading. Additional details can be obtained by writing to manufacturer.

Pacific Transducer Corp, 11836 W Pico Blvd, Los Angeles 64, Calif.

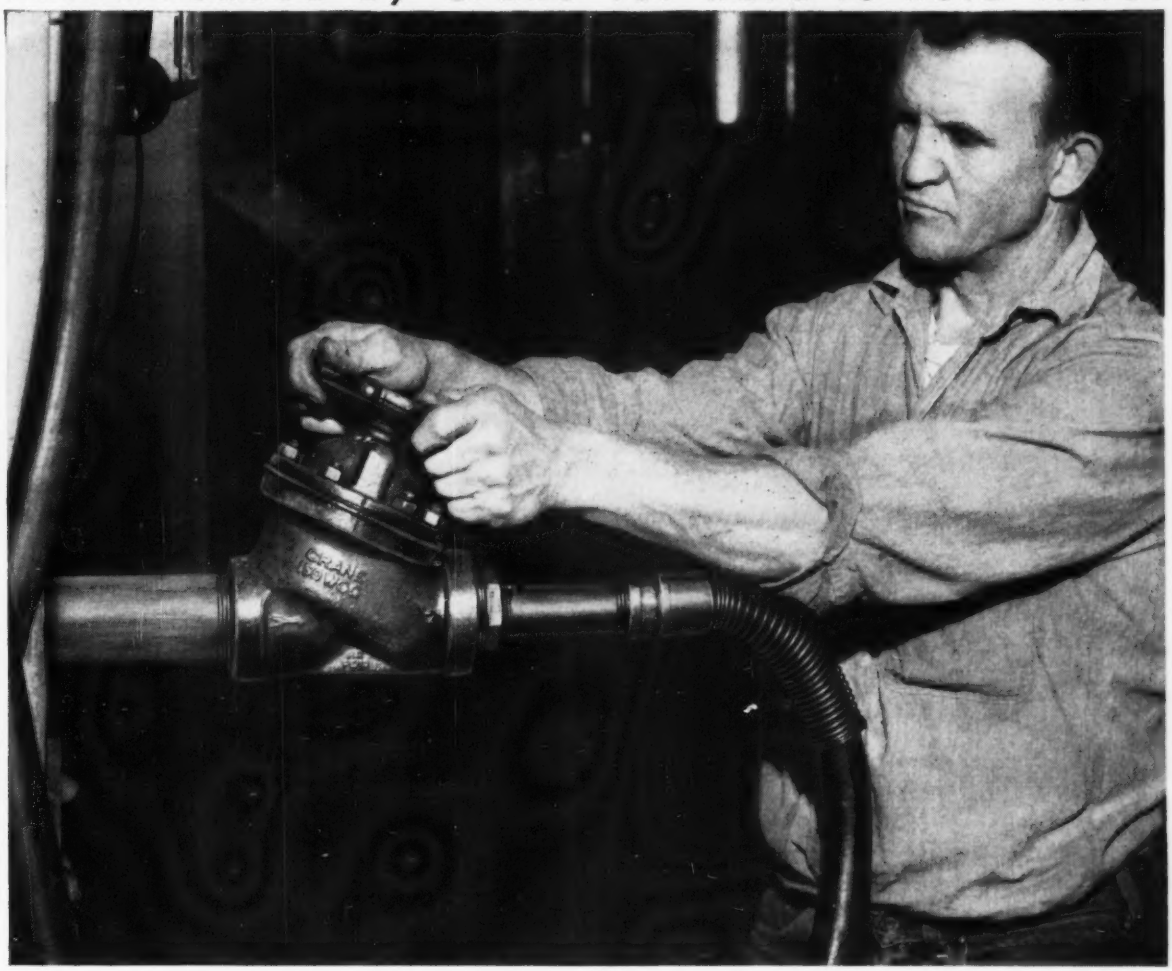
Sonic gas analyzer

305 • Gas analyzer employs the velocity of sound and offers exceptional range, sensitivity and rapidity of analysis, according to manufacturer. Monitoring of gas mixtures by continuous or batch control, detection of minute amounts of harmful gases in pollution or personnel safety problems, vapor and gas chromatography are a few of the analyzer's uses. Request details.

Nat'l Instrument Labs, Inc, 6108 Rhode Island Ave, Riverdale, Md.

For details on these items use post cards on p 171. Identify request with item number.

Recommended by Crane for hard-to-hold fluids



Utility finds these valves ideal for holding transformer oil

Note how clean the valve—not even a sign of oil seepage.

Two years ago, Southern California Edison Co. at its Alhambra shops installed this Crane diaphragm valve on oil refill lines for transformer servicing. Operated about 12 times daily, it has never shown any sign of leakage.

The Utility says they are enjoying exceptional performance with this valve. No troublesome maintenance such as refacing valve seats or repacking stuffing boxes.

Independent seating and bonnet sealing set Crane valves apart from ordinary packless or diaphragm valves. The Crane diaphragm is used only to seal the bonnet—that's why it lasts so much longer. A "soft" insert in the disc face gives tight seating on the hardest-to-hold fluids, liquid or gas.

Ask for this Circular

Moderately priced, Crane diaphragm valves are ideal for many services—common and corrosive. They're made in body materials ranging from iron to stainless alloys. Diaphragm and disc insert available in neoprene, natural rubber, buna N, Kel-F, etc.

Get full information from your Crane Representative or by writing to address below for Circular AD-1942.

CRANE VALVES & FITTINGS

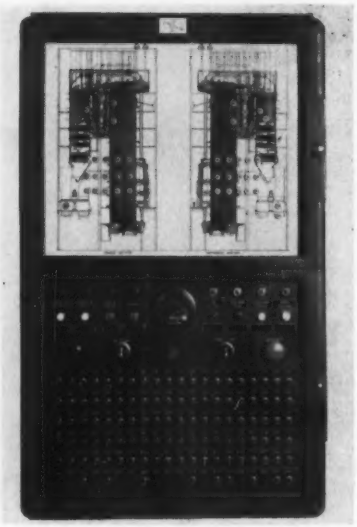
PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

More EQUIPMENT NEWS

Begins on page 162

Need new controls? Check these five items



Sequence controller

306 • Selective sequence controller has up to four repeat cycles for each electrically driven retractable soot blower and wall deslagger in any pre-selected sequence.

Two types are available: *Model SSC-120* with control stations for 120 soot blowers, and *Model SSC-60* with control stations for 60 blowers. Both controllers are complete with indicating lights, master switch, selector switch, malfunction interlocks, annunciators and means for continuous timed blowing programs.

Blowing sequence is arranged and varied by means of a jack board divided into two panels, one for blowers and the other for sequence selection. Each panel contains four jacks for each blower, which permits operating any unit four times in one complete sequence.

Connections between two panels are made by patch cords. Thus, any blower can be operated at any point in the sequence by plugging patch cords into sequence positions selected.

Blowing sequence may be stopped after any step by plugging patch cord between sequence position and stop jack. Details from manufacturer.

Copes-Vulcan Division
Blaw-Knox Co, Erie 4, Pa.

For more details on these items use post cards p 171. Identify your request with item number.

Combustion instruments offer automatic draft control

307 • Line of combustion instruments offer automatic draft control to provide maximum combustion efficiency of gas, oil or stoker-fired equipment, according to manufacturer.

Instruments feature new type cast-aluminum cases which permit either flush or surface mounting as desired. Close control of overfire draft provided by this automatic system is said to reduce costly losses of useful heat. Draft program control, in conjunction with modulator damper actuator, maintains a correct draft for all firing conditions. It is also said to assure safe starting by opening uptake damper prior to burner ignition. This control simplifies installation by providing manual switches, convenient terminal facilities and relays within a single unit.

Companion instruments to provide closer surveillance and additional accuracy are optional. These are: flue-gas temperature indicator, draft gage, steam pressure controller/indicator. Request details from manufacturer.

General Controls Company, 801 Allen Ave, Glendale 1, Calif.

Remote position control features vernier dial

308 • Remote position control has a vernier dial on its face set to establish desired position of valve, variable-speed drive control, jack and rheostat. Control motor, with built-in or externally driven potentiometer, adjusts valve, drive, jack, until proper setting is obtained.

Full-scale follow-up accuracy of ±.002% is standard but precision multi-turn potentiometers may be used to provide accuracies of .0004%, according to manufacturer. Indication by counter rather than by vernier may then be provided. Unit incorporates adjustable anticipation to slow down control motor as desired setting is approached. Details from manufacturer.

The Jordan Co, 3235 W Hampton, Milwaukee, Wis.

Safety-type temperature regulator is self-powered

309 • Safety type temperature regulator, designated *No. 997*, closes automatically to prevent overheating and possible damage to products in process in case thermostatic unit is damaged.

Unit contains a 4⅝-in. bellows for more powerful response and smoother modulating action in controlling flow of steam, hot water or other medium. Because it has a tight-closing, single-seated valve, unit is suitable for "dead end" or terminal service. Sizes range from ¼ to 2 in. Unit is suited for temperature control of industrial processes. Complete details on request.

Fulton Sylphon Div, Robertshaw-Fulton Controls Co,
Box 400, Knoxville, Tennessee

Controller regulates temperature from many points

310 • Multi-point pyrometer controller permits automatic temperature control of 4 to 10 separate units with one instrument. According to manufacturer it combines the accuracy of a null balance potentiometer measuring circuit with speed of an electronic control system.

Unit applies to almost any installation suitable for two position control action—including creep test machines, multi-zone ovens and furnaces, laboratory aging and reaction vessels, batteries of batch process units and others, according to manufacturer. Controller can be set to skip one or more points providing optional control of 4 to 10 units. Details on request.

Thermo Electric Co, Inc, Saddle River Twp, Rochelle Pk Post Office, N. J.

Efficient new pipe covering for outdoor or indoor lines operating up to 1800° F.

Kaylo-20*, a new, highly efficient pipe insulation for service at all temperatures to 1800° F., is made to fit pipes as large as 39″ in diameter. High flexural strength (50 lbs/in²) and compressive strength (100 lbs/in² at 5% deformation) plus light density (12 lbs/ft³) reduce breakage during installation and service, allow easy fabrication. Kaylo-20 is moisture resistant and dimensionally stable, keeps its high strength and efficiency with negligible shrinkage and warpage even under severe service conditions. Outdoors, weatherproof finishes are easily applied. Kaylo-20 is made to simplified dimensional standards, in 3′ lengths, 1″ to 3″ thicknesses.

Kaylo-20 is one of the many quality products in the full line of Armstrong Industrial Insulations. Armstrong also offers you a complete contracting service, geared to install these products economically and efficiently.

For full data on Kaylo-20 or any other Armstrong insulations, send for free booklets. Check the ones you want on the coupon below.

* T.M. Owens-Illinois Glass Co.

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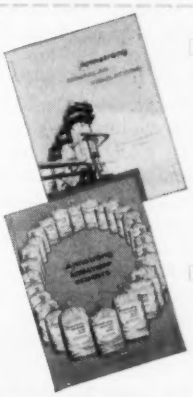
INDUSTRIAL INSULATIONS

☐ Kaylo-20 Insulating Block (data sheet)

☐ Kaylo-20 Pipe Covering (data sheet)



☐ Armstrong Armaglas** Insulations for Piping, Tanks, and Vessels

☐ Armstrong Armatemp† Insulating Cements

Armstrong Cork Company
2303 Riggs Ave.
Lancaster, Penna.

Please send me the free booklets checked.

Please have an Armstrong representative call.

Name .....

Position .....

Company .....

Address .....

City ..... Zone .... State .....

** T.M. Armstrong Cork Co. Manufactured by Owens-Corning Fiberglas Corp.
† Trade-Mark

More EQUIPMENT NEWS

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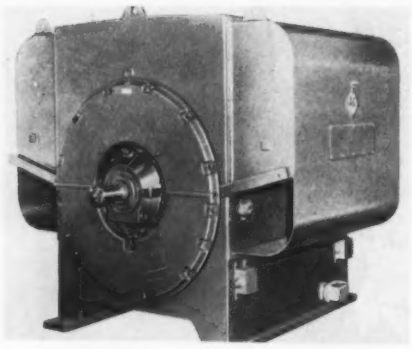


Weather-protected motor

311 • *Type FOD* motor, for nonhazardous outdoor installation, is available in ratings of 250 hp and larger. It is built into a rigidly constructed fabricated steel frame equipped with two removable air ducts. Capsule-mounted sleeve bearings are supported by cast-iron bearing brackets that close the end of frame. The frame houses a removable pre-wound stator assembly unit. Stator leads, completely enclosed and protected, are brought to a diagonally split cast-iron conduit box.

Heavy-steel removable air-intake ducts have openings at each end. Their design is said to minimize (1) effects of high-velocity winds (2) entrance of entrained moisture and particles into the electrical parts of the unit. Motor's contour provides natural drainage, according to manufacturer.

Among applications are petroleum pipeline pumping and refining, chemical plants, powerhouse auxiliary drives, cooling towers, general pumping, mining and mineral processing.

Allis-Chalmers Manufacturing Co
Milwaukee 1, Wisconsin

High voltage starter needs little space

312 • High voltage starter, 2200-4800 volts, measures only 30 in. deep. Unit, designated Type ZHA, is completely accessible from the front and may be mounted directly against the wall or in double rows, back-to-back, according to manufacturer.

Starter is self-contained, complete with control transformer supplying low voltage for pushbutton circuits. When starters are ganged, only one incoming feeder is required. Additional starters can be added as needed. Unit is also available with self-contained bus in an isolated compartment. Furnished in three interrupting ratings.

Electric Controller & Mfg Co, 4504 Lee Rd, Cleveland 28, Ohio

Compound in connectors nips corrosion

313 • L-type compression connectors have both run and tap elements prefilled with corrosion-preventing joint compound. Thus, compound is applied automatically as each connector, tubular or open groove is installed. New connectors are said to save installation time.

A special plastic dip applied directly over the joint compound seals in the proper quantity on the connector contact surfaces. Dipping operation's duration and temperature are controlled to avoid melting the compound and to form a perfect seal. To install, user strips seal by pulling rip tape, color-coded for cable-size identification.

Burndy Corporation, Norwalk 3, Conn.

Silicon diodes for medium power uses

314 • Series of silicon power diodes are rated to deliver 14 to 70 amps and is available in voltage ratings of 50 PIV to 300 PIV. These units are especially designed for medium power equipment where high performance, high ambient temperature, reliability, high efficiency and miniaturization are prime factors. Units may be connected in all standard circuit types. To assure freedom from contamination, diodes are hermetically sealed and mechanical construction is designed for stability and reliability, according to manufacturer.

International Rectifier Corp, 1521 E Grand Ave, El Segundo, Calif.

For more data on these items, use post cards page 171. Identify your request with item number.

High-speed 5-kv circuit breaker

315 • Five-kv magnetic circuit breaker with two-cycle interrupting time has been developed for use on 4.16-kv distribution systems. Six hundred-amp breaker has an interrupting capacity of 30,000 amp (40,000 momentary), and can be applied where conventional 150-mva circuit breakers are now used according to manufacturer.

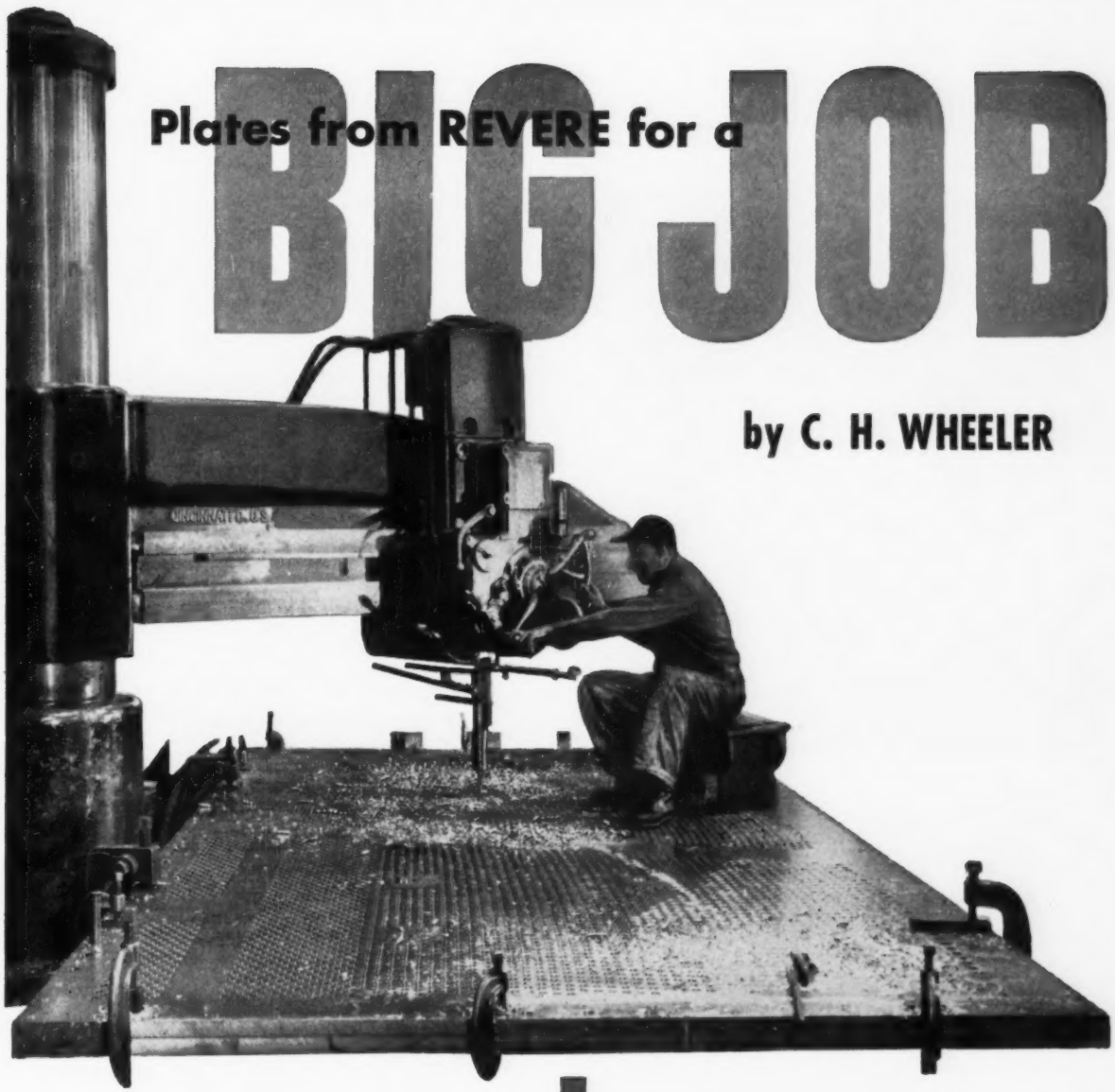
Fast interrupting time is expected to effect considerable reduction in wire damage in clearing faults on overhead lines, thereby permitting improved continuity of service and reduced line maintenance.

All moving parts are made of light-weight, high strength materials to permit high-speed operation without excessive closing currents. Also, roller bearings are used to reduce friction to a minimum. Mechanical refinements with high-speed trip device, permit contact parting time of ¾ cycle after energizing the trip coil. Request details.

Westinghouse Electric Corp, P.O. Box 2099, Pittsburgh, Pa.

Plates from REVERE for a BIG JOB

by C. H. WHEELER



Here you see two rolled Muntz Metal condenser plates, being drilled simultaneously in the plant of the C. H. Wheeler Manufacturing Co., Philadelphia 32, Pa. The plates were supplied by Revere. They measure 100-¾" x 203-¾" x 1-½" thick. Four plates were supplied for a Wheeler 2-pass divided water box unit having 95,000 sq. ft. of condensing surface. The overall length of the condenser, including water boxes, is 48 ft., and overall height, including steam dome and hot well is 34 ft.

Revere is an important supplier of plates and tubes for condensers, heat exchangers, and similar equipment, shipping to all parts of the country. Collaboration on alloy selection and specification is freely available. Just get in touch with the nearest Revere Sales Office.

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Sales Offices in Principal Cities, Distributors Everywhere

More EQUIPMENT NEWS

Begins on page 162

Electronic tool cleans up industrial air

319 • Electronic air cleaner is said to deliver a high-voltage knockout to dust and foreign matter going through it.

Model shown, left, has capacity of 1300 cfm. Other models will range from 1300 to 150,000 cfm. Size of unit is 4x4x3 ft. Unit shown requires 65 watt of power and uses 5 gal water at 30 lb pressure per cell every 7 or 8 months. Power requirements re-rated: 50 w plus 10 w per 1000 cfm.

All necessary electrical equipment is enclosed in a control cubicle. Power consumption is 10 to 15 watts per 15,000 cfm.

Unit works thusly: as dust atoms flow into electronic air cleaner, they pass through a 13,000-v electrostatic field where they receive a positive electrical charge. This overbalances the negative charge surrounding the atom and makes it a positive ion. Positively charged ions are attracted to negatively-charged collector plates (carrying 6500 v of electricity) and are repelled by alternately-placed positive plates in the collector unit. After being collected on negative plates, dust particles are automatically washed away by a water spray.

Unit works thusly: As dust atoms flow into electronic air and air-conditioning systems. Details from manufacturer.

Minneapolis-Honeywell Regulator Co
2954 4th Ave S, Minneapolis 8, Minn.

For more data on these items, use post cards page 171. Identify your request with item number.

Corrosion-proof plastic molds to any shape

320 • Corrosion-resistant plastic fume ducts and hoods, fabricated of a thermo-setting plastic material which is combined with glass or other synthetic fibers, can be produced in virtually any required shape.

Physical properties of hood and duct materials range from 11,000 to 15,000 psi for tensile strength, and flexural strength ranges from 22,000 to 30,000 psi depending upon desired material thickness. Units are said to provide a high degree of resistance to acids.

The Ceilcote Co, 4932 Ridge Rd, Cleveland 9, Ohio

Lubricant suited for high-temperature units

321 • Oil carbon deposits in machines operating at high temperatures are said to vanish when this specialized lubricant is used. This oil resists oxidation, sludging and breakdown, according to the manufacturer.

Lubricant was developed for air compressor use but may also be used on ring bearings in electric motors, multiplate friction clutches, plastic molding heat-transfer systems. Details from manufacturer.

Keystone Lubricating Co, 3100 No. 21st St, Philadelphia, Pa.

Filter shell permits use of any cartridge

322 • Filter shell for lubricants and coolants permits use of any size or type filter media. Necessity of shell replacement and repiping is said to be eliminated when changing from one type filter cartridge to another. This is achieved with a removable cartridge holder which can house any filter cartridge now in use and can be designed for any developed in the future. Request details from manufacturer.

Alpha Systems Div, Alpha Tank Co, 1850 Steinway St, L.I. City, N.Y.

Spray-on coating combats corrosion

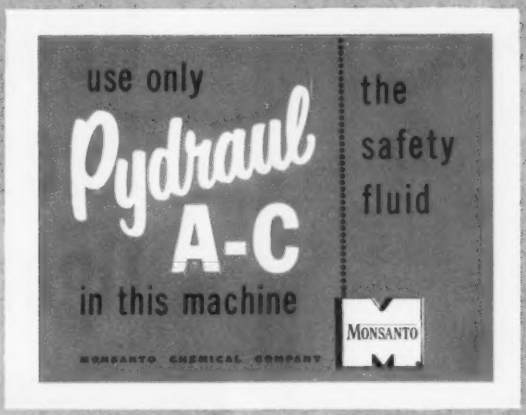
323 • Silicate modified coating has the appearance of paint, is applied by conventional spray equipment, and will dry to the touch on most applications in a few minutes, according to manufacturer. Coating is designed for use where corrosive elements such as acids, alkalies, humidity, moisture and salt are a source of coating-failure and excessive maintenance cost.

Coating is available in colors and also comes in black, clear, white and metallics, in both baking and air-dry grades. It can be applied to virtually any coatable surface including metal (ferrous and nonferrous), masonry, wood and asbestos, according to the manufacturer. Because of its essentially inert composition, it is said to provide a uniform film which resists chemicals. Request details from manufacturer.

Allied Porcenell, Inc,
851 S Market St, Waukegan, Ill.

Check these items too . . .

High-capacity vacuum pumps . . . p 176
Diesel-fuel injection tubing . . . . . p 178
Power beam floodlight . . . . . p 180
Automatic hardness tester . . . . . p 182
Thermocouple components . . . . . p 182
Hydraulic piston pumps . . . . . p 184



This seal on an air-compressor spells SAFETY from lubricant-caused fires and explosions

If you are operating one, ten or fifty air compressors in your plant, here's big news for you. The day of lubricant-caused compressor fires and explosions is *over!*

Now there's a new chemically tailored compressor lubricant called Pydraul AC that not only lubricates like a premium-grade petroleum oil—*it's fire-resistant!*

You'll realize additional savings in Pydraul AC's ability to minimize carbon deposits on air-compressor exhaust valves and air piping systems.

No conversion problems—just drain your flammable lubricant and replace with fire-resistant Pydraul AC—it's that easy.

Service-proved—two years of industry-wide service have confirmed Pydraul AC's *safety* and operating economies for power plants, gas transmission, chemical processing and the basic metalworking industry.

There's a fire-resistant Pydraul for every industrial hydraulic job: general-purpose Pydraul F-9; Pydraul 150 and Pydraul 60 for use in precision equipment; and Pydraul 600 for heavy equipment.

Pydraul: Reg. U.S. Pat. Off.

Write today for your copy of Pydraul AC bulletin.
Organic Chemicals Division
MONSANTO CHEMICAL COMPANY
Dept. PAC-73, 800 N. 12th Blvd., St. Louis 1, Mo.

MONSANTO®
WHERE CREATIVE CHEMISTRY WORKS WONDERS FOR YOU

Two Separate Circuits Mean

Reliable Rectifier Operation

ALLIS-CHALMERS

Mercury Arc Rectifiers

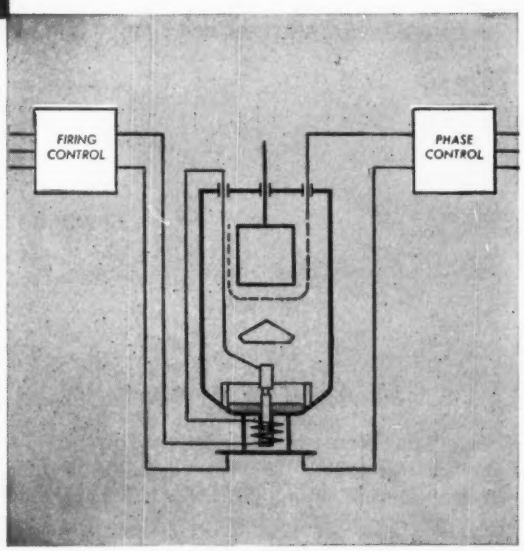
One of four metal-enclosed assemblies in a midwestern installation with a total capacity of 15,000 kw at 620 volts, dc.

1. Firing Circuit

A small dc excitation arc is automatically ignited only once, when the unit is started. It is then maintained on the mercury cathode of each rectifier tube. It offers advantages similar to a pilot light. Since it is far easier to maintain an arc than to start it, this feature reduces the chance of the excitron losing excitation during power supply disturbances.

2. Phase Control Circuit

A separate circuit utilizes the deionizing grid to obtain phase control. Grid-type phase control permits operation in the clean region near the anode where ion density is lowest, instead of on the surface of the cathode mercury pool where there is turbulence and contamination. Reliability of phase control does not depend on the condition of the mercury. This is an exclusive excitron feature.



Only Excitron Rectifiers Provide Separate Circuits

for these two all-important functions. Improved operation results — one function is never sacrificed for the other—you get optimum operation from each.

For Complete Information on rectifier operation, call your nearby A-C office, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS CHALMERS

A-5136

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here →

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New York 36, N. Y.

WATER TREATMENT

1 **Zeolite softeners.** Illustrated 20-p bulletin 4520 deals with necessity for water softening, explains fundamentals of softening and selection of equipment and zeolites. Cochrane Corporation, 17th St below Allegheny, Philadelphia 32, Pa.

2 **Chlorine evaporator.** Unit with maximum capacity of 6000 lb chlorine per day is described in 4-p bulletin 70-21. Fischer & Porter Co, 889 Jacksonville Rd, Hatboro, Pa.

3 **Membrane demineralizers.** Electric membrane method of water demineralization is described in 20-p bulletin 3. Provides design, performance and cost data on units with capacity of 2500 to 2,000,000 gal of demineralized water daily and using input water containing 1000 to 10,000 ppm of total dissolved solids. Ionics Inc, 152 6th St, Cambridge 42, Mass.

4 **Anion exchange resin.** Eleven-page data leaflet 35 describes properties and behavior of *Duolite A-30*, an intermediate base anion exchange resin, especially in water demineralization. Chemical Process Co, Redwood City, Calif.

5 **Boiler feedwater treatment** is subject of 4-p bulletin. Contains info on need for treatment, solution to feedwater problems and dosage control. Western Chemical Co, 713-715 Washington St, Kansas City 5, Mo.

6 **Cold-water deaerator.** Illustrated 4-p bulletin 4653 describes advantages, principles of operation. Cochrane Corporation, 17th St below Allegheny, Philadelphia 32, Pa.

ELECTRICAL EQUIPMENT

7 **Transformer** instruction booklet. DL-1 covers installation, operation, component parts, maintenance and inspection of distribution type transformers in ratings of 250 to 500 kva, 3-phase. Moloney Electric Company, 5390 Bircher Blvd, St. Louis 20, Mo.

8 **Trolley busway** electrification for electrical testing is subject of bulletin 57. Tells what it is, what it does and shows advantages of its application. Feedrail Corporation, 125 Barclay St, New York 7, N. Y.

9 **Electrical contacts.** Illustrated 4-p catalog C-522 describes materials, properties, forms and uses of electrical contacts. Gibson Electric Co, 8389 Frankstown Ave, Pittsburgh 21, Pa.

10 **Indoor power center** transformers, 300 kva and below, are described in 6-p bulletin CS-1010. Self-contained units are suited to lighting circuits, small industry and commercial buildings. Kuhlman Electric Company, Bay City, Mich. (*Continued on page* 220)

NEW EXPANSION JOINT DESIGN

from the world's most experienced manufacturer

- ✓ **Up to 50% Less Weight...**
- ✓ **Longer Cyclic Life...**
- ✓ **Better Equalization**

Series 150 S-R Double Joint, flanged ends, cover removed from one bellows

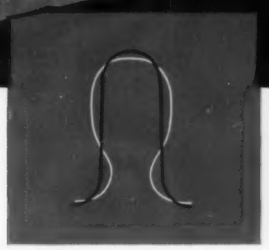
Intensive research program pays off in revolutionary design of Badger S-R Expansion Joints

BADGER S-R Packless Corrugated Expansion Joints — an entirely new design — are now ready for your most exacting power, heating, industrial and process piping applications.

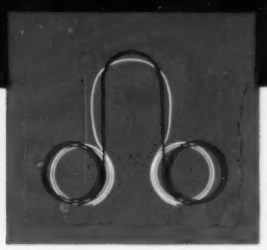
Two significant features of Badger S-R Joints are 1.) Curvilinear Corrugations, which result in natural "all-curve" flexing and more equal distribution of movement among the corrugations; 2.) tubular Reinforcing Rings, which work with the new corrugations to produce greater effective flexing height and "all-curve" flexing even under higher pressures and temperatures.

And there are other important features, too . . . size for size, Badger S-R Joints weigh up to 50% less than conventional types . . . new ring design reduces joint diameter . . . a complete line of accessories — including covers and liners — are available . . . standard models in stainless, monel and inconel, special types in any workable alloy.

Write for illustrated brochure today!



Series 50 corrugation cross-section



Series 150 corrugation and ring cross-section

New corrugation and ring designs produce better equalization, "all-curve" flexing.

The radically different Curvilinear Corrugations used in Badger Series 50 S-R Expansion Joints were developed by the Badger Research Department. When under operating pressure (white line in cross-section above), the new design produces more uniform movement per corrugation and natural "all-curve" flexing. These features result in lower stresses and therefore increased life.

Series 150 S-R Joints also feature Curvilinear Corrugations and, because they are used at higher pressures, have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation yet allow natural "all-curve" flexing (white line). The tubular shape of the rings also permits greater effective flexing height and therefore contributes to longer joint life.

BADGER

S·R

SERVICE RATED

EXPANSION JOINTS

BADGER MANUFACTURING COMPANY • *230 Bent St., Cambridge 41, Mass.* • *60 East 42nd Street, N. Y., N. Y.*

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George Edwards

says, 'Plan your retirement, change frustration to fun'

► AUTHOR Peter Freuchen, in his book *Arctic Adventure*, tells about an old Eskimo woman who'd gone out to tend her trap line just before a howling storm broke. Her neighbors didn't think she'd make it back to the village, but didn't make any effort to rescue her. Instead, they gathered for about a half hour to feel sorry for her. Then, having done their duty, they were going to forget the matter.

It's hard for us to visualize something like that. When the chips are down and a life is at stake, we drop everything to get rescue operations into high gear. And not only for a human being. If necessary, we'd turn out the Army and Navy to rescue a puppy trapped in a well.

These things are generally spectacular, but there's an operation going on right now that, while not spectacular, will save a lot of people from a very real tragedy.

It concerns the thousands of men and women who reach retirement age every year. Until not too long ago a retirement plan meant only that when an employee reached a certain age he'd receive a certain sum of money each month after he was turned out to pasture.

Nobody gave much thought to what the guy would do with himself. Like the Eskimos, we'd feel sorry for him in some cases, but let it go at that.

Now, realizing how completely bewildered and lost a man can be after his lifelong moorings are cut, employers are starting to help him plan for the morning he can laugh at the alarm clock.

One of the first in this field is Union Carbide and Carbon's Linde Air Products Division at Newark, New Jersey. Here, a "Five-Year Club," open to any employee who's within five years of retirement, is doing a bang-up job. Bob Albrecht, Linde's Industrial Relations Manager, explained it to me a few weeks ago.

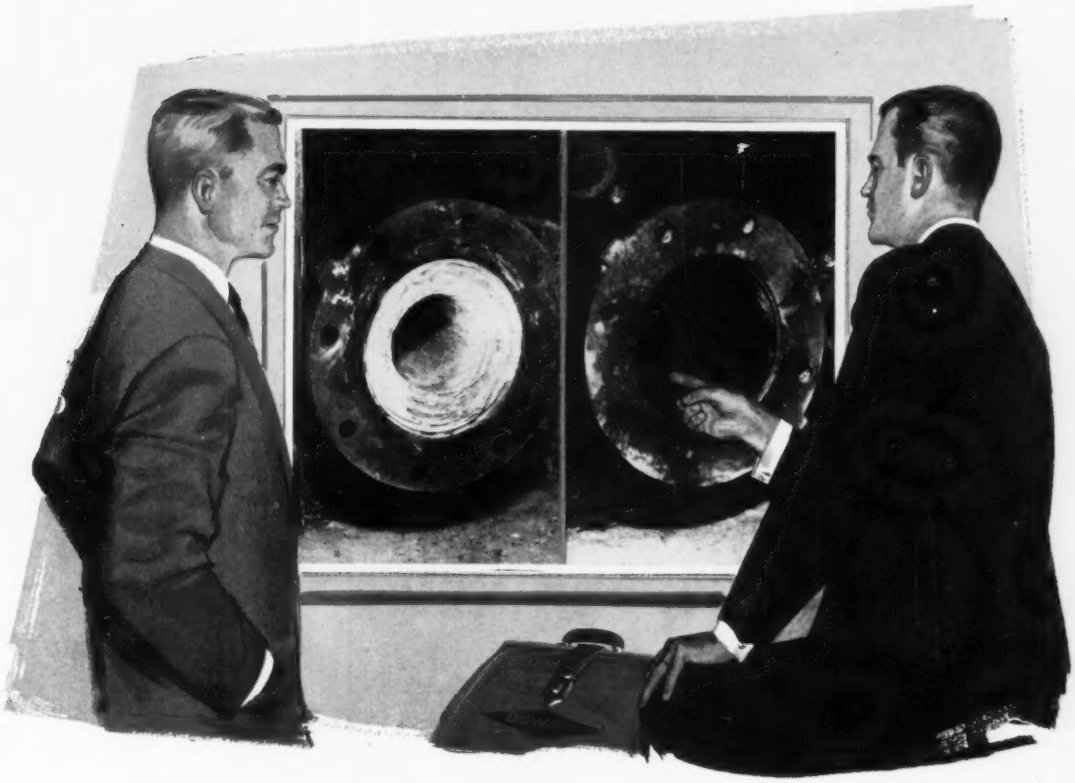
At meetings, members hear experts on health, estate planning, hobbies, social security benefits and other subjects. The two biggest items—income adjustment and what to do with new found leisure—are picked apart and discussed.

When the day comes, the retiring employee knows exactly what he wants to do and just how he's going to go about it.

As Bob Albrecht puts it: "The aim of this voluntary, informal organization is to encourage self-preparation for the personal adjustments—physical, psychological and financial—necessary for satisfying, successful retirement."

Incidentally, Bob added that he'd be glad to give the complete working details to anyone interested in setting up a similar program.

here's how Dowell chemical cleaning saved $71,000 and helped protect a plant profit!



A few months before their peak season, the operators of this plant decided their main water line might not supply the water necessary to meet peak demands. The line was cast-iron, 16-inches in diameter and over 7,000 feet long. Its original flow efficiency or "C" factor had been 105; scale build-up had reduced this to 72. To lay an auxiliary line would cost at least $85,000.

Dowell contracted to clean the pipe chemically for a little less than $14,000, and to restore a minimum of 50 per cent of the line's lost capacity.

This Dowell did, and more—increasing the "C" factor to 92! Enough water was immediately available for capacity operation. This saved the plant $71,000 and helped protect the company's annual profit.

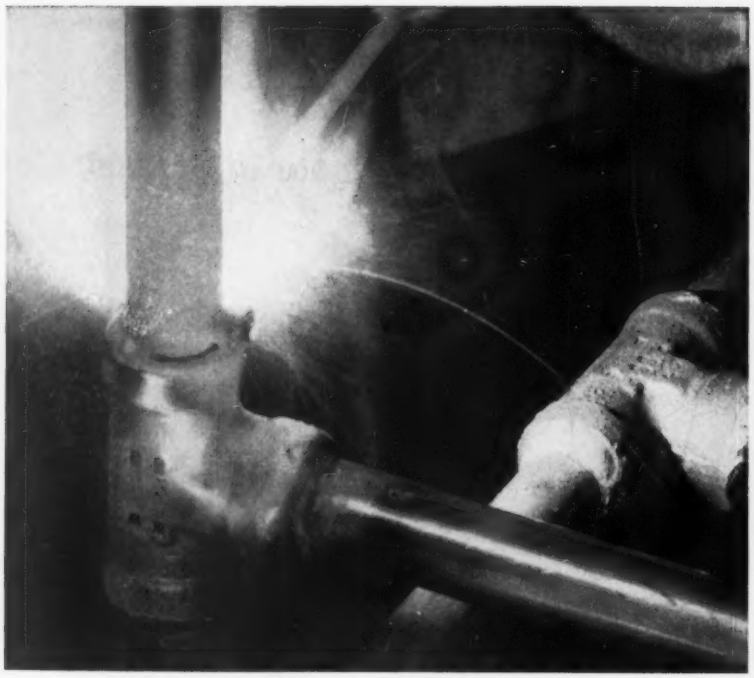
The operating credit realized by this food processing plant, as a result of Dowell service, is similar to those realized by other Dowell customers—in the steel, paper, chemical, oil refining, power and allied industries.

Dowell engineers are experts in the use of solvents to remove scale and sludge—deposits that cut the throughput of product, process and steam generating systems. Dowell does the job, furnishing all chemicals, trained personnel, pumping and control equipment.

For specific information on how chemical cleaning can help you to greater profits, call the Dowell office nearest you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

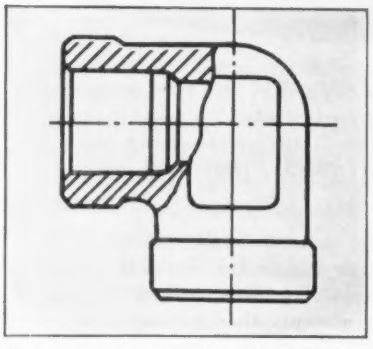
Have Dowell clean it chemically DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

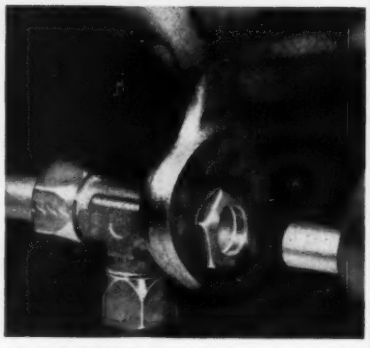


Simply insert tube, then weld! No wonder Parker Weld-lok *tube* fittings are so easy to use . . . by anyone, anywhere. You don't need special gripping fixtures. A tapered socket aligns and holds the tube. The permanently welded joint is unaffected by vibration, shock, or thermal distortion. Especially good under extreme temperature or corrosion conditions.

Use Parker Weld-lok fittings for tubing ¼ through 2" O.D.



Cutaway view of Weld-lok *tube* fitting shows detail of the simple design. All commonly used connectors and body shapes are offered in steel and stainless steel. Send for Catalog 4370 listing shapes, sizes.



Intru-lok fittings are easy to use for copper instrumentation lines. Just insert the tube, then tighten the nut with a regular wrench . . . for a leakproof vibration-proof joint. Also used with plastic tubing. Send for Catalog 4324.

TUBE AND HOSE FITTINGS DIVISION
Section 424-X
The Parker Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio

Parker
Hydraulic and fluid system components

More EQUIPMENT NEWS

Begins on page 162

Safety air vent

325 • Vent is said to eliminate dangers of accumulating vapors in underground storage tanks by permitting vapor to escape easily in an upward direction. This upward projection of vapor eliminates hazards of fire and explosion possible with downvented gasoline vapors. Oversize area of vent is said to allow vapor to escape rapidly without any restriction to flow even under tight-fill service practice.

All parts can be removed quickly for inspection or cleaning. Details on request.

Universal Valve Co,
628 South St, Elizabeth, N.J.

For more details on these items use post cards p 171. Identify your request with item number.

High-capacity vacuum pumps

326 • *Series 4700* mechanical booster vacuum pumps are said to reduce time required for many industrial high-vacuum processes. Available in six sizes from 1000 to 12,000 cfm, these pumps operate at top capacity throughout the broad pressure range of 5 to 2200 microns. Units use no oil, either as a pumping medium or as a sealant in the high-vacuum system. According to manufacturer this makes backstreaming possible, assures clean systems and removes all risk of spoiling costly process materials.

These pumps are multistage units. Low- and high-stage units are mounted on separate bases to allow installation of interstage condensers, filters, traps, valves.

NRC Equipment Corp, 160 Charlemont St, Newton Highlands, Mass.

NEMA 12 panel enclosure

327 • Eight sizes of two-door units, ranging from 54x42x8 in. up to 72x60x12 in. have been added to existing single-door line.

No centerpost is used in construction of these steel liquid-tight enclosures, which

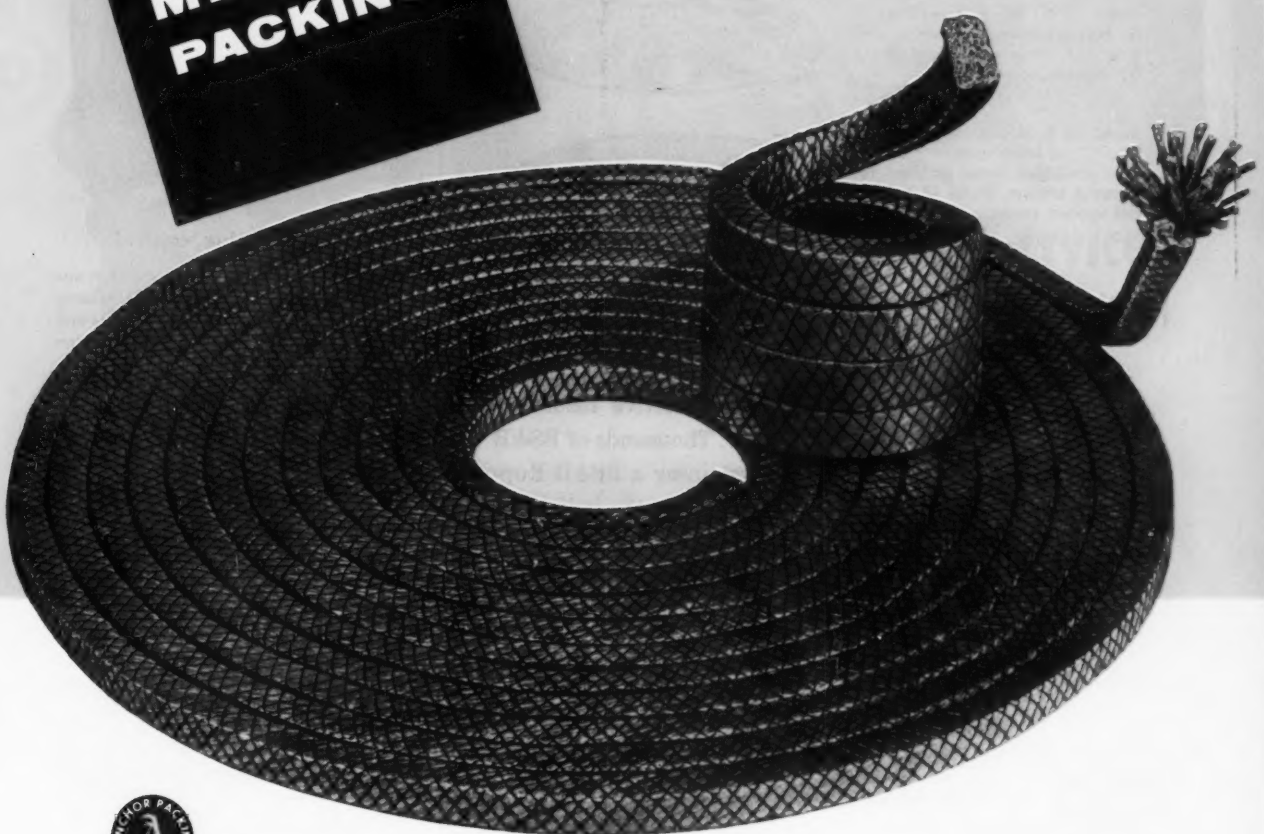
ANCHOR offers you this IMPROVED METALLIC PACKING!

Resilient... Flexible...

Anchor 851-T.T., available in ring, spiral or coil form, readily adjusts itself when pressure is applied to the gland being packed. It is today widely used on temperatures as high as 500°F. and may be used in any service where a Babbitt metal is suitable.

Anchor 851-T.T. is adapted for high speeds of turbines and centrifugal pumps. Thus, properly applied on rods, shafts or plungers that are not scored or shouldered and are running true, it is the most economical packing to use due to low friction which prolongs its life.

For specific sizes, applications and features, write us today.



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THE ANCHOR PACKING COMPANY

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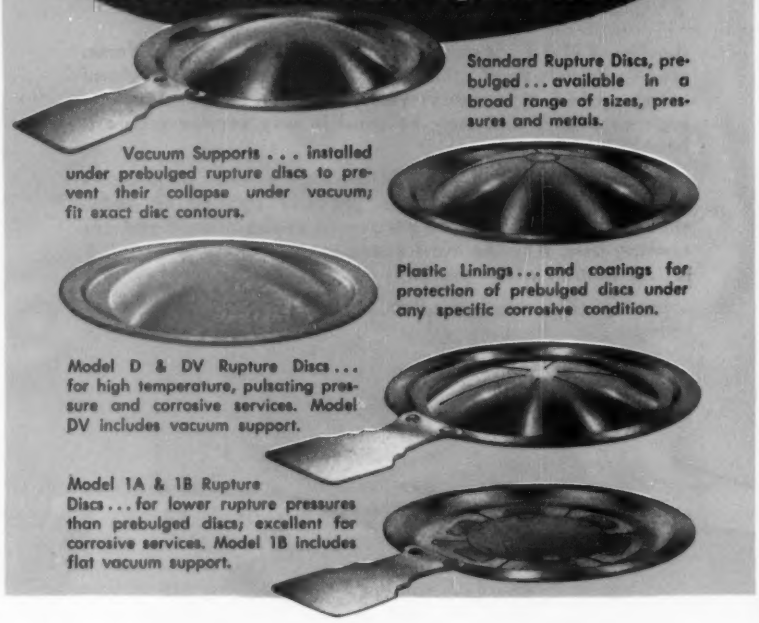
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

These BS&B Rupture Discs Can Give Your Pressured System...



Standard Rupture Discs, prebulged... available in a broad range of sizes, pressures and metals.

Vacuum Supports . . . installed under prebulged rupture discs to prevent their collapse under vacuum; fit exact disc contours.

Plastic Linings... and coatings for protection of prebulged discs under any specific corrosive condition.

Model D & DV Rupture Discs... for high temperature, pulsating pressure and corrosive services. Model DV includes vacuum support.

Model 1A & 1B Rupture Discs... for lower rupture pressures than prebulged discs; excellent for corrosive services. Model 1B includes flat vacuum support.

Positive Pressure Protection From 3 To 50,000 PSI

Installing a BS&B Rupture Disc on a pressured system provides protective insurance against a major disaster. Thousands of BS&B Safety Heads, each containing a BS&B Rupture Disc custom made to meet the individual requirements of the system it protects, are now guarding pressured systems in all types of industries.

Fully accepted by most local and national codes for use as either primary or secondary pressure relieving devices, BS&B Rupture Discs can be *your* positive and final measure of protection for the unexpected emergency.

BS&B Safety Heads

THE "CIRCUIT BREAKER" of Pressured Systems

Why not talk it over with your BS&B Representative... or write for further information to...

OVER 60 YEARS — EFFICIENCY — BS&B — RELIABILITY — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Safety Head Division, Dept. 2-Q3
7500 East 12th Street
Kansas City 26, Missouri

More EQUIPMENT NEWS

Begins on page 162

utilize all welded seams and have no holes. Offset doors are gasketed with neoprene sponge and are secured by a locking handle with a three-point latch.

Enclosures have a 12-in. stand for floor mounting and lifting eye bolts.

Hoffman Engineering Corp
Anoka, Minnesota

Diesel engine control

328 • Control provides automatic start and stop with protective shutdown features. Control operates on 12, 24 and 32 volts and can be used with any diesel engine equipped for storage battery starting. Unit operates from any type of remote pilot switch, including automatic transfer, temperature, pressure, float, or load-demand type, the manufacturer states.

Lake Shore Electric Corp
510 Willis Ave, Bedford, Ohio

For more details on these items, use post cards p 171. Identify your request with item number.

Diesel-fuel injection tubing

329 • Seamless cold-drawn diesel-fuel injection tubing is now available in random length coils for stock in shops which require a wide variety of lengths for repair work. Fifty-foot random coil lengths (minimum 40, maximum 60 ft) come in four sizes: ¼-in. OD x 120-in. ID; ¼-in. OD x .060-in. ID; 5/16-in. OD x .072-in. ID; ⅜-in. OD x ⅛-in. ID.

Coils are furnished in either high-pressure diesel-fuel injection tubing for systems with working pressures up to 9000 psi or in low-pressure tubing for systems with lower working and surge pressures.

Superior Tube Co, 1938
Germantown Ave, Norristown, Pa.

Chemical eyeshield

330 • By using a vinyl hood 11¾ in. long with 78 staggered ventilating baffles, manufacturer claims that more than twice the normal ventilation is achieved by eyeshield. Splashes, dust and other foreign particles

Allis-Chalmers Pumps Meet Power Plant Requirements

Continuous Condenser Service at Detroit Edison's River Rouge Plant

At River Rouge Station, these Allis-Chalmers 84 by 60-inch circulating pumps, driven by 500-hp motors, deliver 73,000 gpm to the A-C condenser.

They play an important part in assuring service continuity at this station. An accurately cast impeller, hand finished and dynamically balanced, assures smooth operation. Other features, including a rigid whip-free shaft, and tube-protected shaft and rubber bearings lubricated with filtered water, have made A-C circulating pumps popular throughout the power industry.

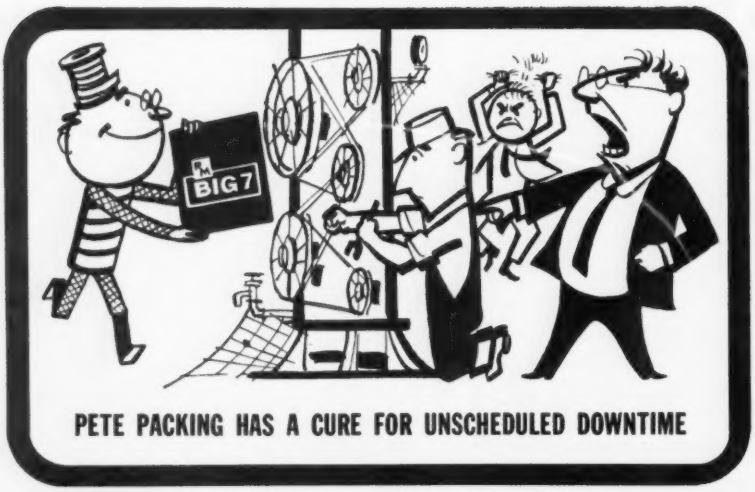
Many customers use Allis-Chalmers test facilities to properly design their intake structures.

You Get **MORE** than a Pump . . . When You Specify Allis-Chalmers

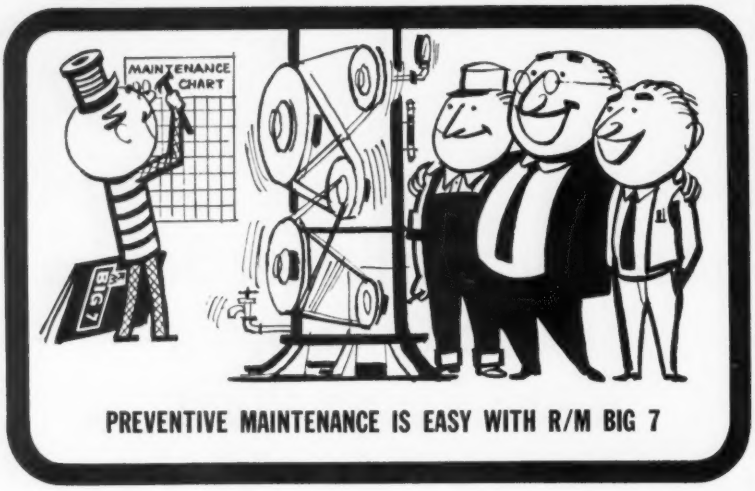
You can take advantage of Allis-Chalmers wide experience in supplying pumps to all industries. You are assured of modern design, heavy-duty construction and correct application aid — all adding up to many years of dependable service.

Allis-Chalmers is the only company that can offer you "One-Source" responsibility, with a complete unit — pump, motor and control — all built to work together. For "MORE" information about Allis-Chalmers pumps, call your local A-C office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin. A-5216

ALLIS-CHALMERS



PETE PACKING HAS A CURE FOR UNSCHEDULED DOWNTIME



PREVENTIVE MAINTENANCE IS EASY WITH R/M BIG 7

With R/M's Big 7 Packing Types you can schedule downtime instead of having downtime forced on you when you can least afford it. Each of the R/M Big 7 Packing Types is engineered to do a specific job, and among them there is practically no packing problem that can't be mastered. In fact, most plants find that they can meet their day-to-day problems with no more than 3 or 4 of these types. As a result, they are able to cut down initial investment, simplify ordering, and reduce inventories. Errors through faulty selection become a thing of the past. That's a lot of advantages for you.

Call in your R/M distributor and talk over your packing problems with him. He knows his business. Let him show you how R/M Big 7 Packings can make life easier for you.

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M packings for maintenance purposes are sold only through authorized R/M distributors

R/M BIG 7 PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

More EQUIPMENT NEWS

Begins on page 162

are further screened out by wrap-around integrally-molded stainless steel 20 mesh screen. Screen ventilation permits air to flow freely to eliminate hazardous fogging.

Full vision toward normal work level is possible by a design which tilts lens in towards cheekbones. Details on request.

United States Safety Service Co
1215 McGee St, Kansas City, Mo.

Power beam floodlight

331 • Unit is reported the highest powered portable unit made in its size and weight. Producing 121,500 cp with a 500 watt rating, unit weighs 13 lb complete with 2000-hour power spot or flood, 25 ft detachable 3-conductor cord with plug and adaptor, and protective lens with guard.

Unit is available as portable or truck mount with heavy mounting plate instead of tripod. Both types are fully adjustable in any direction and are equipped with large cast aluminum positioning knobs to lock focus in any direction.

Stonco Electric Products Co,
333 Monroe Ave, Kenilworth, N. J.

For more details on these items use post cards p 171. Identify your request with item number.

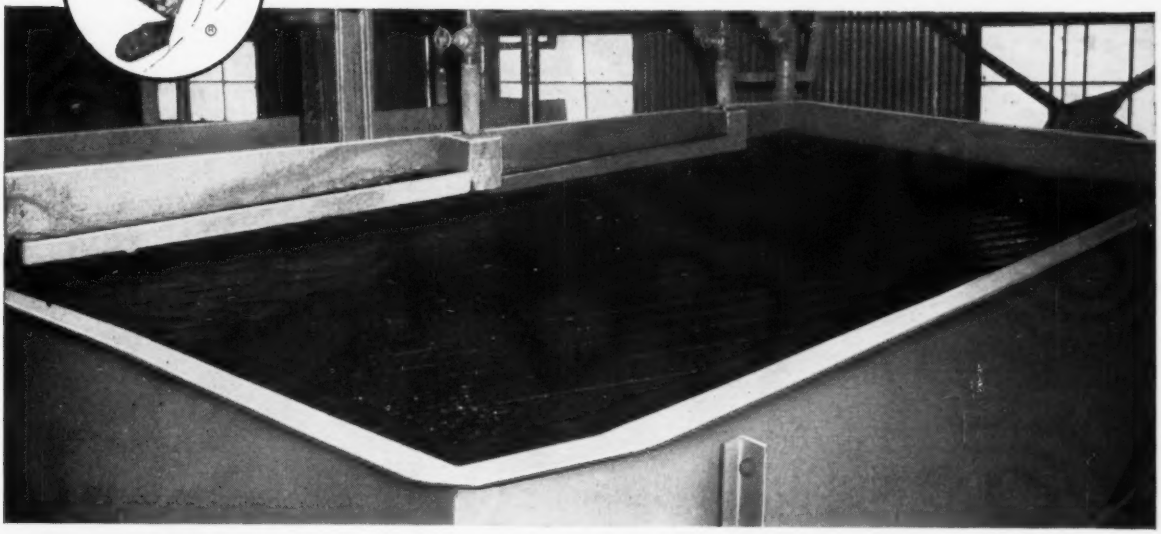
Entrainment separator

332 • Corrosion-resistant unit is suited for removal of liquid particles from air and other gases. Type MV scrubber is compact self-contained unit ready for inserting in a pipeline.

At a pressure of one velocity, scrubber is designed for gas approach velocity of approximately 30 ft per second, at which pressure drop is less than 1 in. (water column). Pressure drop is lower under vacuum conditions. At velocities twice those designed for, reentrainment occurs, but is retarded by tear-drop cross section of separator rods.

Impervious graphite materials in scrub-

WHY CHESSIE'S RAILWAY IS FIRST IN COAL



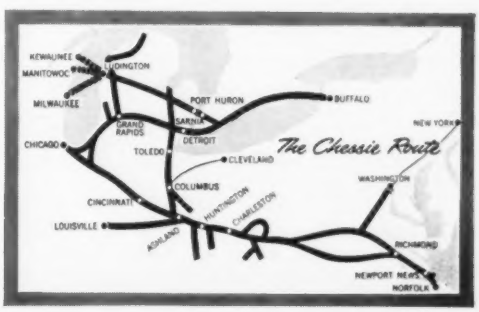
SUPERIOR COAL. This Deister Table for washing slack is an example of the up-to-date methods employed by producers on the C & O to give you the highest quality and performance in the type of coal best suited to your needs. Superior coal means lower ultimate cost.

SUPERIOR SERVICE. Chesapeake and Ohio operates the world's largest fleet of coal cars with ample power to move them. By its prompt repair program C&O keeps more than 99% of these cars in good order. And C&O's new car reporting system can give you the exact location of any car on C & O lines at any time.

For dependable deliveries of top quality coals, contact coal producers on the C&O. And if you need help in meeting your own particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Co., Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL



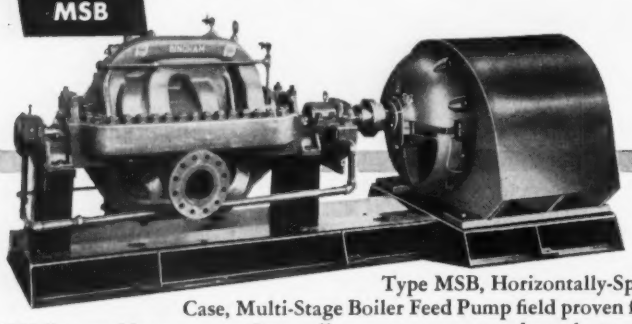
Specify

Bingham

"DOUBLE VOLUTE"
BOILER FEED PUMPS

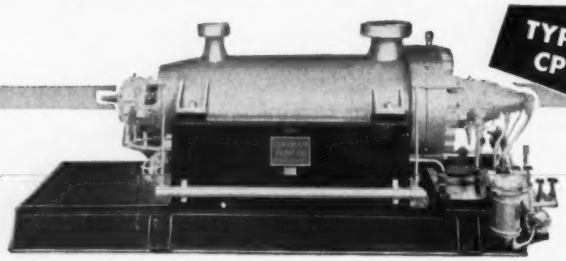
for the ultimate in dependability
IN HIGH PRESSURE SERVICE

TYPE MSB



Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: 2800 N. W. Front Ave., Portland 10, Oregon
Factories: Portland, Ore. • Vancouver, B. C., Canada

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Houston, Texas	St. Louis, Mo.
Kansas City, Mo.	St. Paul, Minn.
Los Angeles, Calif.	Tulsa, Okla.
New Orleans, La.	Toronto, Ont., Can.
Vancouver, B. C., Canada	

More EQUIPMENT NEWS

Begins on page 162

ber are chemically inert to mineral acids, organic solvents, salt solutions and other corrosives.

Unit can be operated at temperatures ranging from 340 F to –40 F and at pressures from full vacuum to 65 psig.

National Carbon Company
30 E 42nd St, New York 17, N. Y.

Automatic hardness tester

333 • With this unit, it is possible, according to manufacturer, to automatically classify up to 1000 Rockwell tests per hour on large production runs by hand-feeding individual pieces. Unit will test any metal on the regular Rockwell scale, such as A, B, C, D, E, F, G, H and K.

Unit will automatically classify tested work pieces into one of three categories—correct, too hard or too soft. Device has controlled hardness limits as close as two Rockwell numbers, is equipped with an automatic counter and has an automatic safety stop for pieces not properly fed.

American Chain & Cable Co, Inc, 929 Connecticut Ave, Bridgeport 2, Conn.

For more details on these items use post cards p 171. Identify your request with item number.

Flange union

334 • Flange union with socket weld connections will withstand high operating pressures (to 3000 psi for schedule 80 pipe). Manufacturer says that he can provide special unions incorporating the same design to withstand pressures to 10,000 psi.

Union can be reassembled many times and still retain its original sealing qualities. Flange union is available for pipe sizes ranging from ⅛ to 6 in.

Almar Hydraulic Valve Co
10011 Meech Ave, Cleveland 5, Ohio

Thermocouple components

335 • Plug-in thermocouple components are designed to simplify and speed-up connection of thermocouples to industrial instruments.

Connecting units can be used for either single or multiple thermocouple connections. Contact inserts are manufactured of compensating materials suitable for use

Research-Cottrell 1956 Orders for 20 Central Station Precipitators

Consolidated Edison Company
STATION: ASTORIA • UNIT NUMBER: 3

Consolidated Edison Company
STATION: ARTHUR KILL • UNIT NUMBER: 2

New England Power Company
STATION: SALEM HARBOR • UNIT NUMBER: 3

A Prominent Southeastern Utility
2 PRECIPITATORS

Tampa Electric Company
STATION: GANNON • UNIT NUMBER: 2

Union Electric Company of Missouri
STATION: MERAMEC • UNIT NUMBER: 3

A Prominent New England Utility
1 PRECIPITATOR

New York State Electric and Gas Corporation
STATION: MILLIKEN • UNIT NUMBER: 2

Public Service Electric and Gas Company
STATION: BERGEN • UNIT NUMBER: 1 AND 2

The Hartford Electric Light Co.
STATION: MIDDLETOWN • UNIT NUMBER: 2

Virginia Electric and Power Company
STATION: CHESTERFIELD • UNIT NUMBER: 2

Delaware Power & Light Company
STATION: INDIAN RIVER • UNIT NUMBER: 2

Commonwealth Edison Company
STATION: FISK • UNIT NUMBER: 19

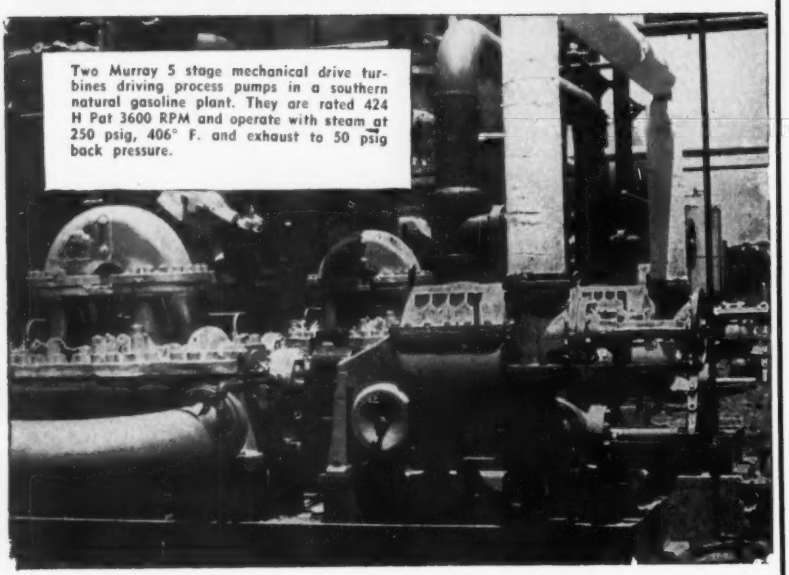
The Detroit Edison Company
STATION: ST. CLAIR • UNIT NUMBER: 6

Research-Cottrell

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, New Jersey • 405 Lexington Ave., New York 17, N. Y.
Grant Building, Pittsburgh 19, Penna. • 228 No. La Salle St., Chicago 1, Ill. • 111 Sutter Bldg., San Francisco 4, Cal.

RC174

Murray Turbines



Two Murray 5 stage mechanical drive turbines driving process pumps in a southern natural gasoline plant. They are rated 424 H Pat 3600 RPM and operate with steam at 250 psig, 406° F. and exhaust to 50 psig back pressure.

● MURRAY TURBINES for mechanical drive can be furnished for various combinations of the following conditions:

Horsepowers up to 15,000
Speeds up to 11,000 RPM
Steam up to 600 psig, 750° F.
Back pressures up to 300 psig., or condensing

● MURRAY mechanical drive turbines are built in various combinations as follows:

Single stage turbines
Multi stage turbines
Mechanical fly ball type governors
Oil pump direct acting oil governors
Oil pump oil relay governors
Fly Ball oil relay governors
Single governor valve with or without hand valves
Multiple automatic governor controlled inlet valves

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

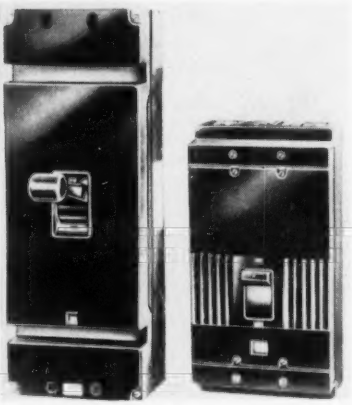
Builders of Steam Power Equipment for Three Quarters of a Century

More EQUIPMENT NEWS

Begins on page 162

with thermocouple types, *JETS* and *R*. One contact is slightly larger than the other to prevent improperly polarized connections. Details from manufacturer.

Minneapolis-Honeywell Regulator Co, 4494 Wayne Ave, Philadelphia 44, Pa.



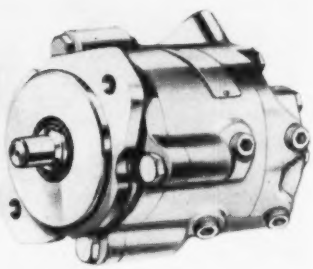
Circuit breaker

336 • 800-amp molded case circuit-breaker is 6½ in. shorter than conventional breakers of the same rating.

Breaker design, designated the KM-frame, covers applications now using M-, L-, and KL-frame sizes. One frame can now be used for all ratings from 125 through 800 amp. Manufacturer states, savings in space up to 30% for each breaker are possible in ratings above 400 amp.

General Electric Co, Plainville, Conn.

For more details on these items use post cards p 171. Identify your request with item number.

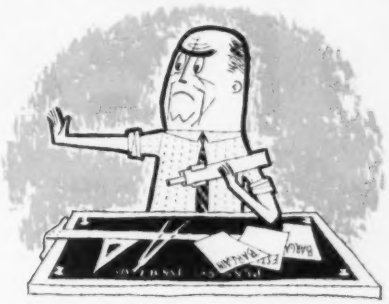


Hydraulic piston pump

337 • Unit is said to be in the price range of gear- and vane-type pumps. *Series PF-3006* has a 3000-psi max intermittent pressure and a rated pressure of 2000 psi. Manufacturer says that pressures developed by this pump permit design engineers to reduce size of oil lines, fittings, valves and cylinders that make up hydraulic system. Fitting adapters are available with straight threads or pipe threads. Shaft rotation can be in either direction and unit can be mounted in any direction.

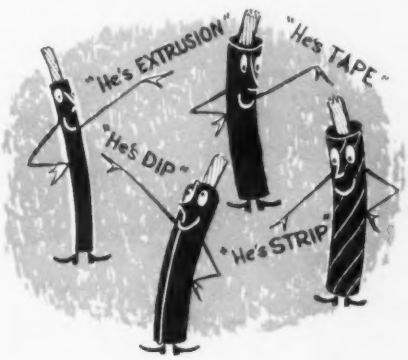
Dynex, Inc, 1500 S Muskego Ave, Milwaukee, Wis.

Listen, friends, to the hideous fate of the man who learned about cables too late



Lucius K. Watt was an engineer
He was eager and honest and able,
And one of the things he did for his firm
Was to buy electrical cable.

Now he knew all the people at Okonite
But with orders he'd seldom reward 'em,
"Because," he would state, "the cables are great
But who in the world can afford 'em?"

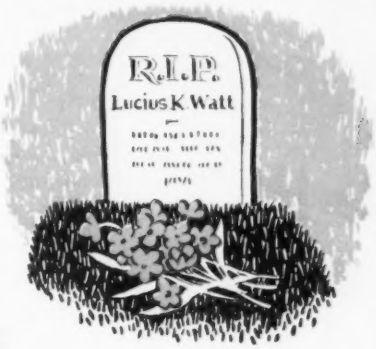


(Now that was a fault of the late Lucius K's—
That he had such a silly illusion;
For Okonite insulates cables *all* ways:
Strip, taping, dip and extrusion.

Only Okonite uses all methods, you see—
Our prices are *not* always highest;
And thus when you ask us what cable to use
Our recommendation's unbiased.)

So Lucius K. Watt went out and he bought
A cable he heard was a bargain
And this was too bad, for Lucius was had . . .
By some Madison Avenue jargon.

The thing was installed (with a minor defect)
In a most inaccessible place;
When Lucius K. Watt went out to inspect . . .
The cable blew up in his face!



We hate to relate this horrible fable
But here is the moral for all:
If you should desire a superior cable—
By extrusion or strip . . . by taping or dip
Just write us a letter, or call.

No matter *what* insulation or method of application you want (and we use them all) you'll get the best of its kind from Okonite. For a frank, down-to-earth discussion on cable insulating methods, write for Bulletin PW-1106, The Okonite Company, Passaic, N. J.

where there's electrical power . . . there's **OKONITE CABLE**

4754

5 CHESTERTON PACKINGS expressly developed for STEAM

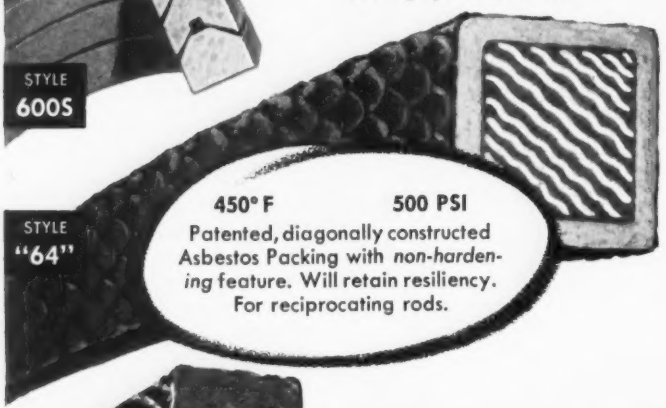
HEAT . . . . . PRESSURE

1000°F **2000 PSI**

A 95% pure asbestos braided yarn with monel wire insertion. Mica lubricated. For extreme heat and pressure service.

550°F **1000 PSI**

Improved self-sealing moulded Asbestos Packing with multiple feather sealing lips. All services.



450°F **500 PSI**

Patented, diagonally constructed Asbestos Packing with *non-hardening* feature. Will retain resiliency. For reciprocating rods.

350°F **125 PSI**

Soft, highly lubricated Asbestos Packing for medium to low pressure and fast moving shafts.

750°F **1000 PSI**

Compressed Asbestos Sheet. Homogeneously constructed with complete graphite impregnation. Cuts easily. *"Lasts as long as the iron."*

Send for new brochure.

PACKING Chesterton SERVICE

A. W. CHESTERTON CO. • EVERETT 49, MASS.
America's Oldest Manufacturer of Mechanical Packings

PLANT VENTILATION

Continued from page 113

in this respect. Probably because most engineers have more experience with the former, they try to apply their knowledge of the characteristics of air blowing *from* openings to a job involving suction openings. Drawing, top p 113, shows why this won't work. A relatively high velocity can be created at some distance from the end of a pipe under pressure, because air in motion possesses a lot of energy. Using suction to create the same velocity in reverse would require a tremendous exhaust rate. Combined factors of directional velocity and inertia act entirely different under these conditions.

Radiant-heat control is another situation in which some engineers overlook the fact that heat in this form doesn't lend itself to control by ventilation. This doesn't mean that men or equipment exposed to radiant heat can't be cooled by ventilation. But ventilation has no effect on the amount of heat reaching the man or object. Ventilation serves to remove heat faster from the man by convection and sweat evaporation, and from an object by convection. It doesn't decrease one iota the heat received by man or object from the radiation source. Consideration of this fundamental principle of heat transfer by radiation can mean money saved on heat-control ventilation.

Radiant-heat shielding is generally the best bet. This method can use any material that is opaque to infrared rays. However, many materials have a high coefficient of absorption for infrared energy. They heat up, become secondary sources of radiation and don't reduce the load to the best advantage.

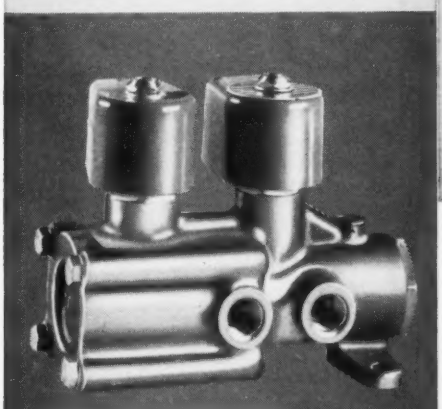
Stainless steels, aluminum and some other materials have a low absorption coefficient and reflect most of the infrared energy. Consequently they're effective shields, and they don't heat up unless they're in contact with the hot surface. Another advantage is their low coefficient of emissivity—if they should become heated through physical contact with a hot surface, they radiate only about 5% as much heat as many other materials.

A good example of effective shielding is a rolling mill pulpit, photo, top right, p 112. Here, radiant-heat load was reduced tremendously by applying aluminum sheets to all exposed surfaces except the windows. While this procedure does not always eliminate the need for air conditioning, it can decrease the cooling equipment's required capacity.

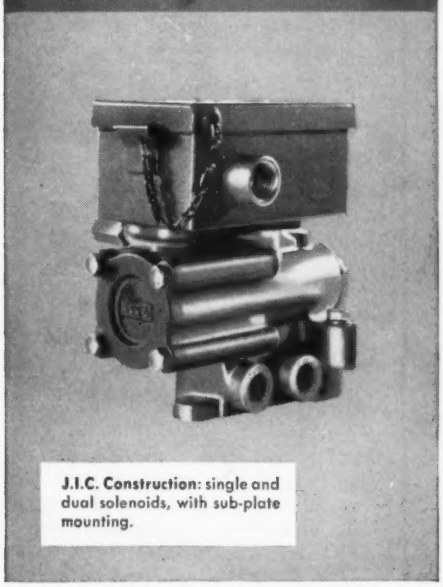
Maintenance problems involving equipment subject to harmful amounts of radiant heat can be solved by shield-

Now available: full line of ASCO 4-way solenoid valves

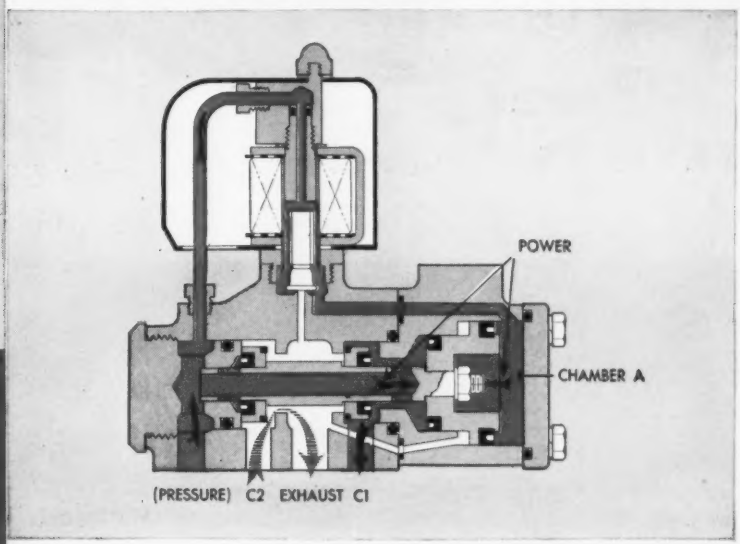
Single Solenoid: operates when solenoid is energized; returns automatically when de-energized.



Dual Solenoid: operates when either solenoid is energized; will not return until opposite solenoid is energized. Solenoids may be energized continuously or momentarily.



J.I.C. Construction: single and dual solenoids, with sub-plate mounting.



power driven in both directions by line pressure

Now available in ⅜" through 1" sizes, these valves are positive in action. When the solenoid is de-energized, *line pressure* applied to the top of the pilot core forces it off the seat, eliminating possible sticking caused by residual magnetism. *Line pressure* is applied to Chamber A, moving the piston-disc assembly to the left. When the solenoid is energized, Chamber A is exhausted and *line pressure* drives the piston to the right.

absolutely tight seating — no leakage

Combination of metal to metal and resilient seating provides dead tight shut-off — even on air. No grinding, lapping or close adjustments are necessary.

Available in standard, watertight or explosion-proof solenoid enclosures, the Bulletin 8344 permits cycling rates to 850 per minute — mounted in any position. Design simplicity eliminates maintenance problems.

J.I.C. construction available

These 4 way valves are available in all sizes to meet J.I.C. (Joint Industry Conference) standards. Valves are provided with sub-plates, vapor-proof solenoid enclosures, and manual overrides, and are electrically inoperative when the cover is removed.

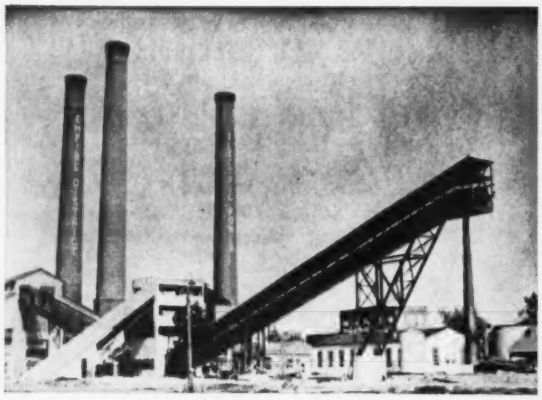
New ASCO Condensed Valve Catalog No. 201 is now available. Write today for this basic reference on solenoid valves.

AUTOMATIC TRANSFER SWITCHES
SOLENOID VALVES ELECTROMAGNETIC CONTROL

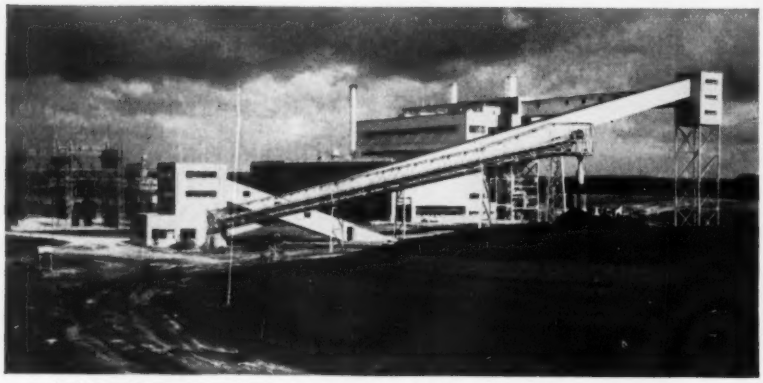
Automatic Switch Co.
541 Hanover Road, Florham Park, N. J. FRontier 7-4600

ASCO

EARN EXTRA PROFITS IN SAVINGS



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.



McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

—With Cost-Cutting

COAL-HANDLING SYSTEMS

Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

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McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ **Title**_____

Company_____

City and State_____

PLANT VENTILATION

Continued from page 186

ing. Photo, top left, p 112, shows how aluminum installed on the hot sides of electrical conduits protect them from the heat load produced by nearby coiled hot strip. Prior to installing the shielding, intense heat in the conduits caused wire insulation to deteriorate quickly. Elsewhere in this plant, radiant-heat shields were installed to lessen motor maintenance. Before shielding, motors had to be rewound almost monthly, but now are rewound at intervals of more than a year.

A word of caution in connection with reflective shielding for radiant heat: Shielding material can act exactly like a mirror and, if used unwisely, may create a serious radiant-heat problem in an area where no heat problem existed before. All incident heat not reflected directly back to the primary heat source by the shield will be reflected in other directions, just as visible light would be reflected if the shield were a mirror.—*From a paper presented by Dr Brandt at Jan 1956 meeting of Philadelphia Section, AISE.*

MARMADUKE

Continued from page 150

beaten track put us on our own. But some of the brass had a way of expecting us to do the impossible. All of a sudden they'd want the job done now —or yesterday.

"In those days we worked long hours up in that wild country. But after a stretch at a steady grind, I'd disappear for a few days and relax. I'd usually take a couple of my bachelor side-kicks from the plant with me.

"My hideout was a fishing hole a few miles up the river. There we'd fish and soak up caraboo—a local drain cleaner of white whiskey and red wine that the natives got galvanized on. Before heading back to work, we'd tidy up the shack so everything would be shipshape for our next visit.

"Lamartine is muskeg country, so sand and gravel was hard to find. But we needed plenty of it at the plant. Luckily, there was a good gravel deposit directly across the river from us. With all the construction work lined up, that deposit, right under our noses, was a godsend. And all we had to do was dig it up and haul it to our side of the river.

"The engineering department designed a barge to haul the stuff and the carpenter shop built it, using mostly old railroad ties. I anchored an electric winch on either side of the river to

(*Continued on page* 194)

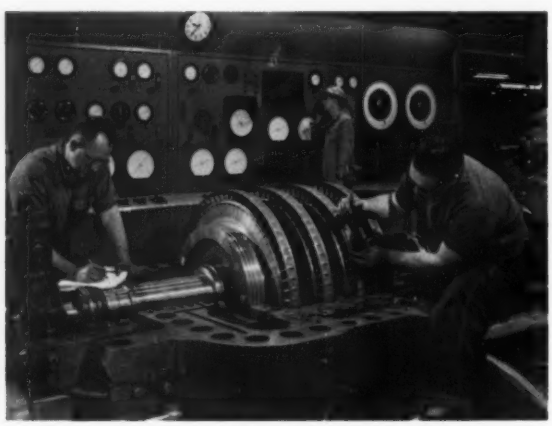
To help find answers to your power generation problems before they occur

TURBINE-GENERATOR TESTING PROGRAMS are co-ordinated in G.E.'s Turbine-Generator Development Laboratory.

Tomorrow's problems are explored today

IN GENERAL ELECTRIC'S TURBINE-GENERATOR DEVELOPMENT LABORATORY

Full-size turbine and generator parts and a great variety of development setups can be tested and evaluated for service performance at General Electric's Turbine-Generator Development Laboratory. Especially designed testing equipment—some described briefly on these pages—provides answers and engineering data that could not possibly be obtained before. This Laboratory, now in full operation, is of vital importance to all large steam turbine-generator development engineering. It supplements the Large Steam Turbine-Generator Department's Materials and Processes, and Air Test Laboratories.

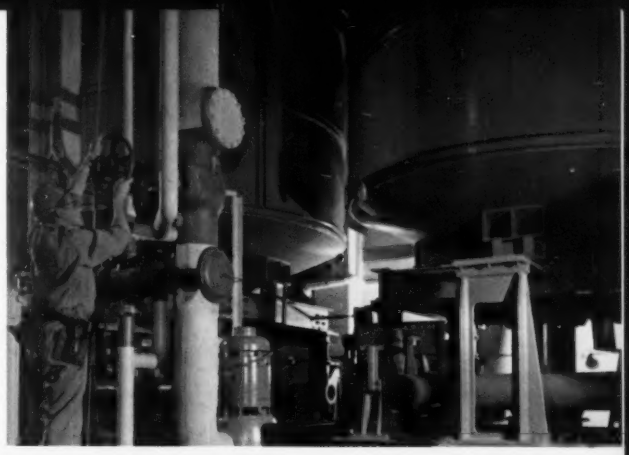


INCREASE TURBINE EFFICIENCIES—High-pressure test turbine provides precise operating data on new bucket, nozzle, rotor and shell designs, leading to higher efficiencies.

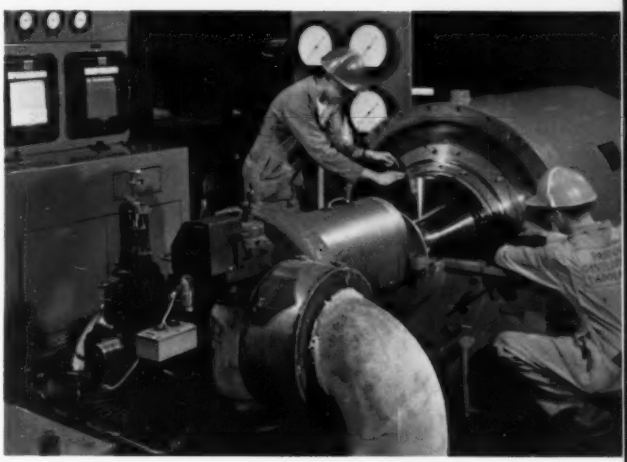
HIGH-SPEED BURST PIT shown on preceding page spins turbine and generator rotor cross sections and reveals fracture characteristics and effects of physical configurations.

INCREASE GENERATOR RATINGS—To increase generator ratings without great physical size increase, more effective dissipation of heat must be provided by improvements in the fans and the cooling systems. Prototypes of fans designed to cool higher-rated generators are run in this full-scale fan test setup. A new fan is being tested here for a 300,000-kw unit. Pressure-volume characteristics and efficiency can be determined—information vitally needed for good fan design.

DETERMINE TURBINE EFFICIENCY—Accurate determination of overall efficiencies of new turbine designs is one of the most important considerations in building future turbines. And an inherent part of this problem is the development of more accurate flow nozzles. Here, the calibration of a water flow nozzle is being checked, using large, highly accurate scales and weigh tanks.

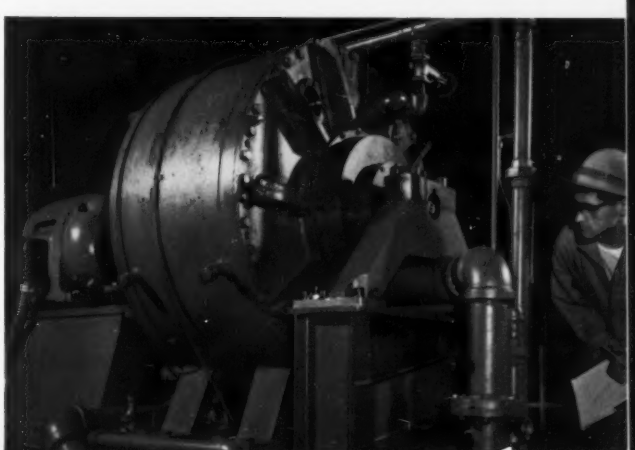


IMPROVE THRUST BEARING DEPENDABILITY—Thrust bearings of larger capacity are required for the larger turbines being designed. The machine shown here is used to test new thrust bearing designs. Operating at 1800 or 3600-rpm, it can impose loads up to 450,000 lbs—equivalent to the weight of the Statue of Liberty. It is also used to measure oil and babbit temperatures, and oil film pressures and thicknesses under conditions tougher than those encountered in actual operation. This machine has proved the dependability of General Electric thrust bearings.



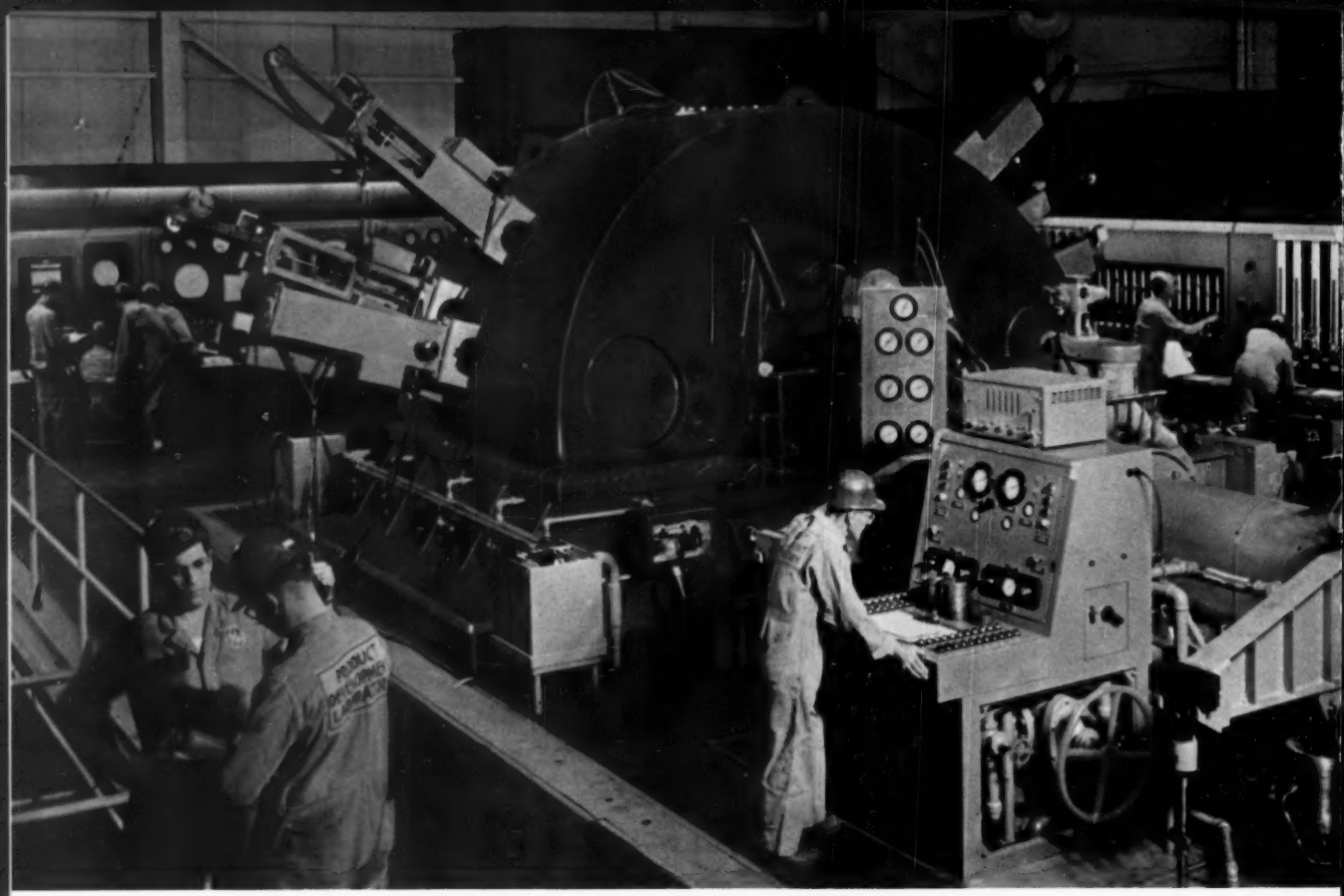
INCREASE GENERATOR INSULATION LIFE—Insulation is one of the most important factors affecting the life of a generator. That is why General Electric conducts extensive research aimed at prolonging insulation life. On this special "girth crack" test setup, a generator stator bar is subjected to simulated operating conditions. Thermal expansion is duplicated and ten years of operating cycles are condensed into four months of testing. Engineers can study and design new insulation systems that will reduce operating difficulties.

SIMPLIFY HYDROGEN SYSTEM—With this test set up General Electric engineers are working to develop a new shaft seal to permit the application of the continuous scavenging system on all generators regardless of size. This system requires no vacuum treatment of the oil.



Progress Is Our Most Important Product

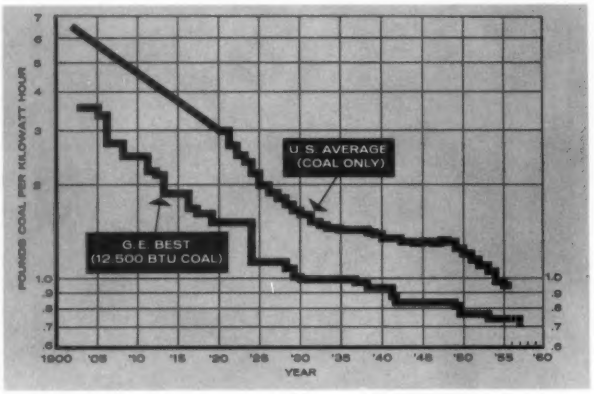
GENERAL ELECTRIC



FULL-SCALE, LOW-PRESSURE TEST TURBINE enables G-E engineers to evaluate new design concepts and to study turbine steam paths under actual operating conditions.

IN GENERAL ELECTRIC'S DEVELOPMENT LAB

Low-pressure turbines get critical study



STATION COAL RATE chart shows rapid progress in electrical equipment efficiency. U.S. average is from FPC reports, compared with station coal rates for G.E.'s most efficient units.

As the rating of steam turbines has continued to increase, a greater proportion of a unit's output is being produced by the low-pressure section. In addition, the advent of nuclear power has further established the importance of efficient use of the energy in this region.

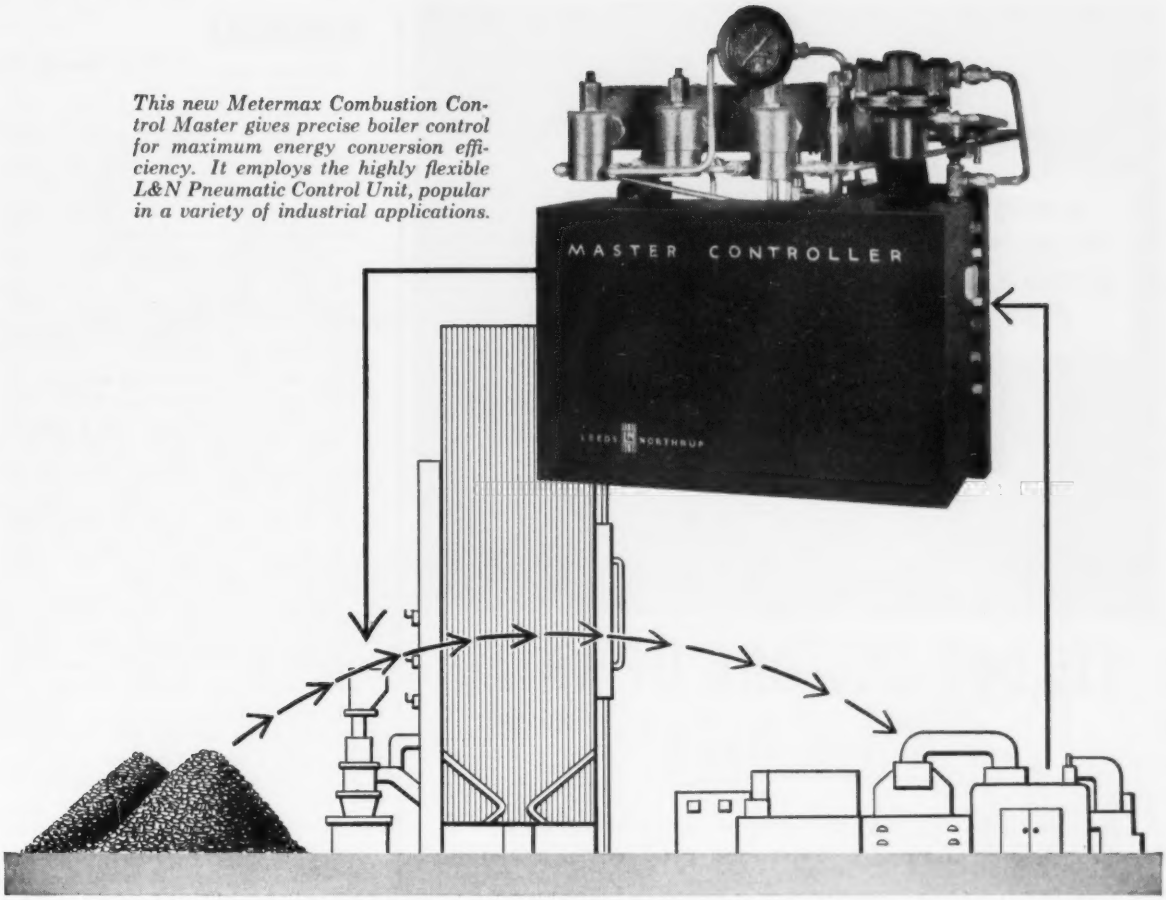
The solution to problems in the low-pressure section can be evaluated in the Turbine-Generator Development Laboratory's full scale, low-pressure test turbine. Here the largest 3600-rpm turbine parts built by General Electric can be run under actual operation conditions.

With facilities like these, G-E engineers can solve power generation problems before they occur—so that tomorrow's turbine-generators will be even more efficient. For more information write for bulletin GED-2554, Large Steam Turbine-Generator Dept. General Electric Co., Schenectady 5, N.Y. 254-47

Progress Is Our Most Important Product

GENERAL ELECTRIC

This new Metermax Combustion Control Master gives precise boiler control for maximum energy conversion efficiency. It employs the highly flexible L&N Pneumatic Control Unit, popular in a variety of industrial applications.



Let this "cost-conscious" brain

HELP SOLVE YOUR COMBUSTION CONTROL PROBLEMS

■ The widely-used Metermax Combustion Control now features this new Master Controller which gives you precise, stable boiler control over a wide load range. Because of its unitized design this Master coordinates the three fundamental control actions. Thus, you're assured of a precise blending of: *proportional action* to meet boiler load changes, *reset action* to maintain a constant steam pressure at all loads, and *rate action* to gear response to the speed and intensity of load swings.

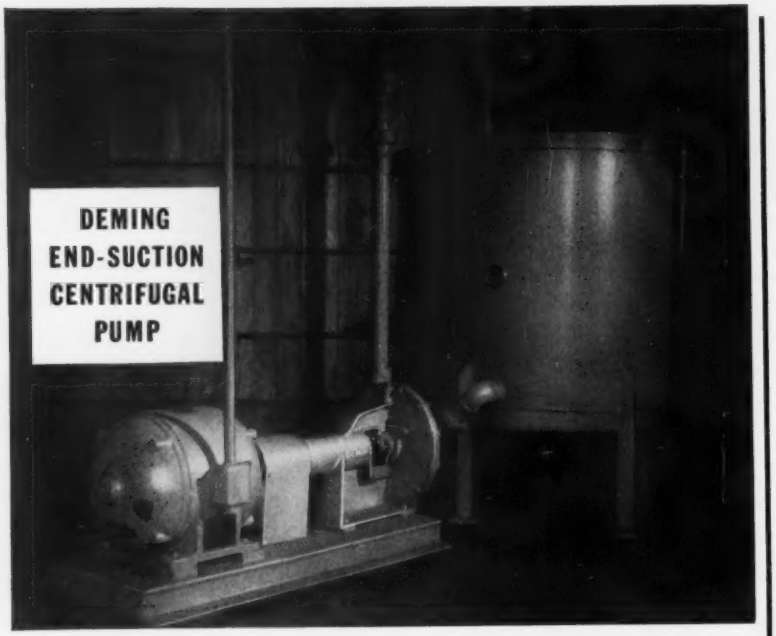
You get wide-range stability because the Master automatically "modulates" its own response as boiler load decreases to reduce control action at low loads for maximum stability. Your proportional, reset, and rate settings, once made to meet a given boiler load condition, are correct for all loads . . . automatically. You need not change or compromise your initial settings. These settings are easy to make, with an independent, calibrated dial for each action.

Boiler operators find this Master easy to work with. First, they can transfer to automatic quickly, because they can balance it to existing boiler conditions simply by turning a single, panel-mounted knob. The transfer is "bumpless," there's no boiler upset . . . no operator attention is needed after transfer. Second, operators get instant action from the Master because there are no long control tubing runs. Control circuits are electric all the way from the control room to the "control center" where the Master and the individual Metermax Controllers are located. This, plus electric transmission to the electric drive units, provides instant response. And third, the Master adjusts itself as load decreases, for low-load stability, thus relieving the operators of this additional duty.

Precise control . . . wide-range stability . . . fast response . . . ease of operation. That sums up what you can expect of Metermax Combustion Control.

For more information on this Metermax Master, write to Leeds & Northrup Company, 4910 Stenton Ave., Philadelphia 44, Pa.

LEEDS NORTHRUP
instruments *automatic controls* • *furnaces*



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The Obstacle: An overtaxed well that supplied water at close to capacity with no reserve.

The Solution: A revised cooling system which included a Deming End Suction Centrifugal Pump and a fresh water supply tank. Water is pumped rapidly through cooling lines and returned to the tank. A self-acting temperature flow valve opens a tap to permit fresh, cool water to supply the system as needed.

The Savings: The Deming Pump and the revised recirculating system reduced the amount of water required by 115,000 gallons per day. So successful is this system that three similar systems are now in operation by the same company.

What's YOUR pumping problem? The diversified line of *standardized* DEMING PUMPS gives you a wide selection for type, size and capacity. Write for details.

THE DEMING CO., 547 BROADWAY, SALEM, OHIO

DEMING

"the Line that has Everything"
IN
PUMPS AND WATER SYSTEMS

MARMADUKE

Continued from page 188

ferry the barge with steel cables. My boys rigged it to hold the barge against the strong current. While all this work was going on, Pierre Rigaux, the super, ordered a three-quarter cubic yard shovel for digging and loading the stuff.

"One Monday morning when I came back from a fishing trip, I saw the shovel, next to the maintenance shop. It had been driven off a flat railroad car a few minutes before. A crowd of office and shop men had stopped on their way to work to give it the once over. That shovel sure was a beauty.

"She weighed about 40,000 lb and had caterpillar crawlers. Besides the shovel, she had a backhoe, clamshell, pile driver and crane or drag line. She could be changed on the job without adding or removing any gears, clutches or shafts in her upper-frame machinery. That shovel would be handy in more ways than one. I had to admit that Pierre used his head, even if he didn't consult me before ordering it.

"My hands were itching to try her out. I hopped into her cab and started the engine. She purred like a well-fed kitten. After giving her controls the once over, I ran her back and forth along the railroad tracks for a hundred feet or so. She was easy to handle and bristled with power. I could feel her trying to flex her muscles, but I held her in check. 'Well, what do you think of the old girl?' beamed Pierre, after I brought her back and hopped out.

"'She's OK,' I answered. 'I'll also add she's the neatest hunk of metal on caterpillar crawlers that I ever handled, and I've handled and repaired plenty of them.'

"'That's fine,' boasted Pierre, throwing out his chest with pride. 'When I spend money, I don't overlook anything. Now we'll have all the gravel we need, eh Marmy?', he boasted.

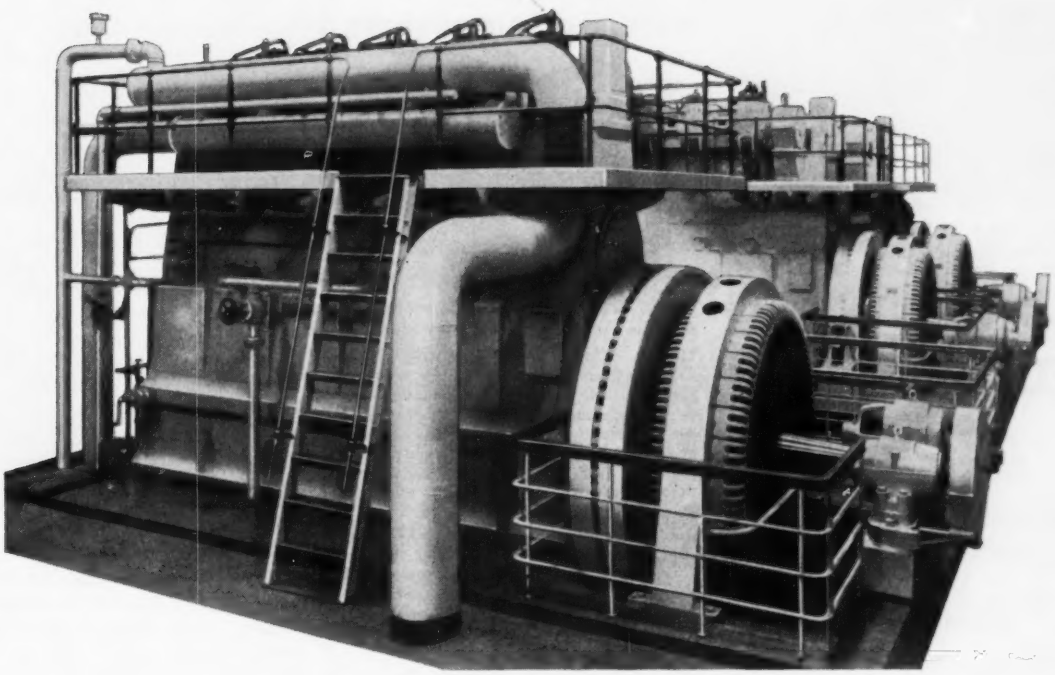
"'Oh yea?,' I answered, looking across the river to that gravel deposit. 'There's just one little problem.'

"'Problem?' echoed Pierre, raising his voice and getting up a head of steam. 'We got the sand barge built and here's the shovel. And by Christopher, it's big enough to dig all the gravel we'll ever need on this job, eh Jean?' he asked, poking Jean Dac, the chief engineer in the ribs.

"'That's just your problem,' I answered. 'Here's the shovel on this side of the river, and there's the gravel deposit on the other side. Now all you have to do is get the shovel to the deposit. Or were you figuring on moving the deposit to this side so it would be near the shovel?' I kidded.

"That did it. Pierre and the boys

STOP { Carbon Sludge Varnish



There's good reason why Sinclair RUBILENE® Oil has a great record in industrial Diesel applications. RUBILENE prevents the formation of carbon, sludge and varnish in Diesels. It stands up under highest operating temperatures, provides better lubrication protection to cylinders, pistons, rings and other vital moving parts. It cuts oil consumption, reduces service time to a minimum.

Now's the time to switch to Sinclair RUBILENE. Whatever the make or age of your Diesel, whatever your lubrication problem, there's a RUBILENE or RUBILENE HD Oil that precisely meets your requirements. Call your Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation.*

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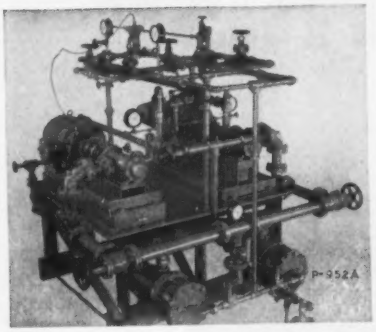
NATIONAL AIROIL

SERVING INDUSTRY'S COMBUSTION REQUIREMENTS FOR 43 YEARS

NATIONAL AIROIL
FUEL OIL PUMPING and HEATING UNITS



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

Complete range of sizes and models in both medium and high pressure types . . . *more compact than ever!* Write for Bulletin 40.

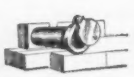
NATIONAL AIROIL
COMBUSTION ACCESSORIES

AIR CONTROL DOOR and FRAME

FUEL-OIL SUCTION STRAINER

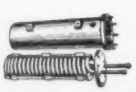
WIDE VIEW PEEPHOLE

IGNITION PORT



FURNACE RELIEF and ACCESS DOOR

FUEL-OIL HEATER



These and other "accessory items" for every industrial liquid fuel-gas installation. Ask for Brochure No. 10.

NATIONAL AIROIL BURNER

NATIONAL AIROIL
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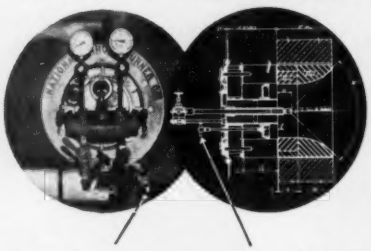

Control for Air Vane — Control for Refractory Faced Disk

BETTER PERFORMANCE with NATIONAL AIROIL Universal Registers because they have a DUAL FEATURE for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disc control. Both adjustments can be made while the burner is firing.

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

MARMADUKE

Continued from page 194

suddenly started looking across the river, then back to the shovel. The river was about 200-yd wide and about 35-ft deep at that point. Rigaux hadn't thought of getting that iron monster across the water. The barge was OK for handling the sand and gravel, but wasn't big enough to carry the shovel across, not by a long shot.

"Rigaux's face clouded and some of the boys started laughing and wisecracking. Pierre just stood there, hands in his pockets, puffing away at his pipe and staring across the river. I walked away to round up my gang for our day's work and left Pierre to stew in his own problem.

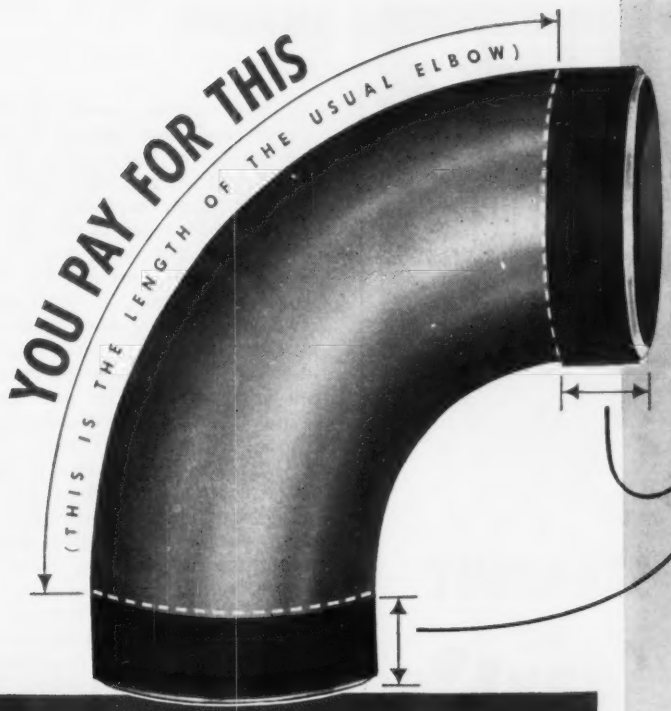
"That shovel wasn't my immediate headache. But I figured I'd have to help out sooner or later. By noon she was dubbed *Pierre's Folly*. Almost everyone was wisecracking about it. There was a lot of speculation on how Pierre was going to get her over. And plenty of wild ideas were flying around, especially since no bridges crossed the river within a hundred miles.

"Poor old Pierre was really in a pickle. For two days screwy rumors popped all around. One was that Pierre was going to take the shovel apart and lug her over piece by piece. But that was a major operation. Another was that he might build a barge big enough to take her across in one piece. But the strong river current at that time of year made this the least practical solution, even if we had time to build such a barge. Another was to wait until the river froze over, then run her across on heavy timbers placed over the ice.

"That Saturday evening the big boss was due in from the main plant in Toronto, from where Rigaux had recently been transferred. He was throwing a dinner to celebrate Pierre's 25th year with the firm. It was to be held at the King George Tavern, a dozen miles up towards the Minninaiba River, at 8 pm. Everyone from foreman up was invited.

"The boys knocked off at Saturday noon, but I stuck around with Jim Dodd, my assistant. Most of the boys lived at St. Catherins, a wide place in the road a few miles across the hill from the plant.

"When Jim and I finally got to the tavern at 9 pm, the party was in full swing. Dinner was almost over so we had to hurry to catch up. And you guessed it, everyone seemed to be kidding poor old Rigaux about that shovel. 'Hi, Pierre,' yelled Charlie Stenke, the young welding boss. 'Why don't you let me weld wings on that shovel so she can fly across, har har



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21% to 42% MORE ELBOW AT NO EXTRA COST

It's a built-in bonus that comes right with the elbow . . . a tangent or straight section at each end of the fitting.* Benefits of this bonus . . . this extra value . . . are yours AT NO EXTRA COST because Midwest "Long Tangent" Elbows are PRICED THE SAME AS OTHER ELBOWS. It's a value you can't afford to miss.

For additional information, ask your Midwest distributor or write us for Catalog 54.

*Size 24" and smaller have tangents equal to ¼ nominal pipe size; for example, 12" ell has 3" straight ends. Above 24" pipe size, all tangents are 6" long.

ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

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THEY COST NO MORE THAN OTHER ELBOWS

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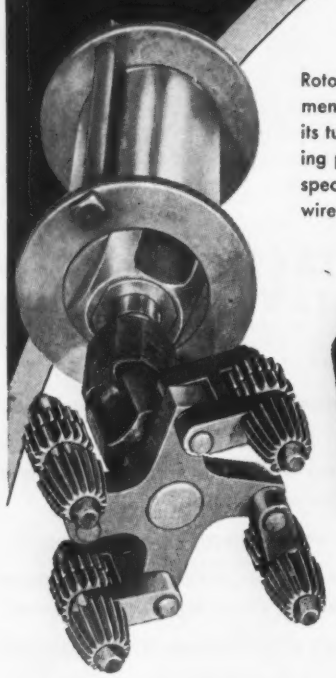
Cleans TUBES and PIPES

ANY SIZE

from ½" to 12" I.D.

STRAIGHT or CURVED



Roto engineers are constantly designing new equipment to meet new conditions and applications for its tube cleaners. If you have a pipe or tube cleaning problem, we will be pleased to place our long specialized experience at your disposal. Write, wire or

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Illustrated are a few of the many types and sizes of Rotojet Tube Cleaners driven by air, steam or water. We analyze each application before recommending equipment that best meets the requirement.

ELLIOTT COMPANY - ROTO DIVISION

Tube Cleaner Specialists Since 1910

153 Sussex Avenue, Newark, N. J.

MARMADUKE

Continued

har!' And everyone roared with him.

"Pierre had been taking it good naturedly, but he was starting to sizzle inside. 'If you guys think you're so smart,' he finally exploded, I'll bet twenty-five dollars none of you can tell me how to get that shovel over!'

" 'Make it a hundred and I'll have her across tomorrow,' I challenged. That brought the roof down. Everyone guffawed. 'Tomorrow,' Pierre laughed with tears running down his cheeks. Then he reached for his pen, wrote out an IOU for one-hundred dollars and handed it to me.

" 'Marmy', he started with a straight face, getting to his feet. 'If you get her over not tomorrow but in the next two weeks, you got this hundred dollars coming from me personally.' Then he sat down, waiting for my answer.

" 'And if you can get her across inside of three weeks,' piped up Francis Carco, the works manager from Toronto, 'I'll give you another hundred.' He was feeling pretty good and figured he had me.

"That brought the roof down again. The boys thought I got my head caught in the reciprocating feed pump that time. They shut up fast, waiting to see what I'd say.

" 'Thank you Mr. Rigaux and Mr. Carco for the two-hundred dollars,' I said quietly. 'I would put up some cash myself and raise the ante. But this is Pierre's party and I want him to have a good time. So you'll both be happy to know that your shovel is already across the river.'

"That crack was like dropping a bomb. For a second no one said anything. They just stared at me as if I had a loose knibbling pin. Then they busted out laughing again, because they didn't believe a word I said.

" 'That's right,' piped up Jim Dodd, my assistant. "Marmaduke and I got *Pierre's Folly* across the river before we came here this evening. That's why we were late.'

" 'How'd you do that?' croaked Pierre suddenly, jumping to his feet as everyone stared at me in disbelief.

" 'Simple,' I answered, lighting up a high-priced nickel cigar. 'First thing I do when I have an engineering curve thrown at me is to make sure I know my known quantities. I explored that river and found a spot that's only about 4-ft deep at one point. It flows over a flat bed of rocks. All that Jim and I did was to drive that shovel a half mile up river to that spot, just this side of my fishing hole. So your shovel is at the gravel bed right now, ready to start your 26th year in high gear.—*SME*

DETROIT ROTOSTOKERS SATISFY

Liggett & Myers Tobacco Company met increased process steam demand

BOILER PLANT MODERNIZED

By C. D. FAULCONER ... and ... ENGINEERS.

Better combustion, higher efficiency, adequate smoke control, reduced coal and ash handling, and more constant pressure at high rating with new boiler, spreader stoker and auxiliaries.

More Capacity Needed

VIEW OF FIRING AISLE
New Stoker in Foreground

SOUTHERN POWER & INDUSTRY for DECEMBER, 1956

62

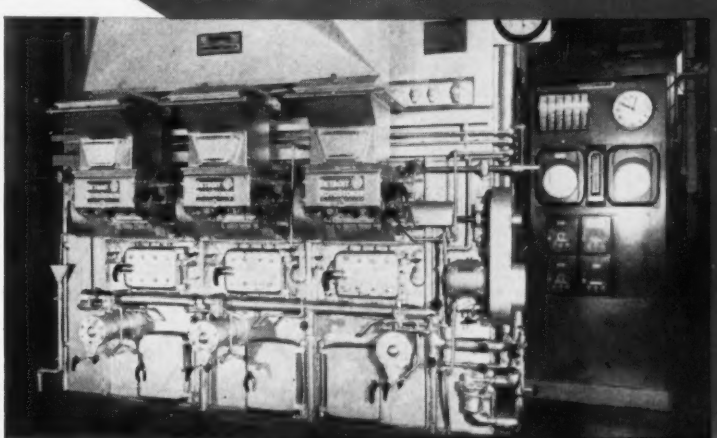
Write for this reprint today

This article should interest you.

It tells how the Chesterfield Richmond plant was modernized. A Detroit Roto-Stoker-fired Babcock and Wilcox Integral-Furnace boiler increased the steam-coal rate from 7.6 to 11.7.

Detroit RotoStokers will save you money. Contact our nearest district office or your consulting engineer.

"They Satisfy"



Detroit RotoStoker at Liggett & Myers Tobacco Company Richmond, Virginia Plant

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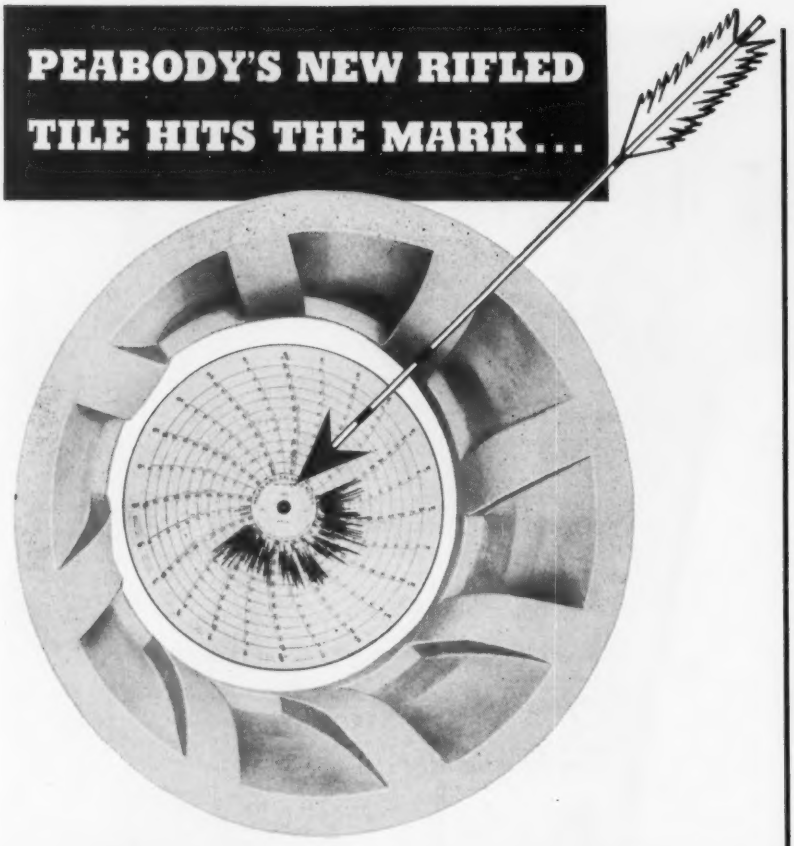
DETROIT SINCE 1898 STOKERS

PEABODY'S NEW RIFLED TILE HITS THE MARK...



over 30 to 1 range instantaneously; 2% steam pressure variation with complete stability and safety, burning gas

A new, basic concept of gas firing, Peabody's rifled tile maintains ignition under the most adverse conditions with assured safety, even when controls break down or go out of adjustment. Specially designed, this rifled tile develops continuous, low-velocity eddy currents, in the rotating air and fuel mixture, which rapidly ignite and serve as continuous, *positive* pilots. Available on new or old Peabody installations, this tile—applied to Peabody Ring-fired Gas Burners—permits minimum load on gas without regard to wind-box pressure settings and with complete safety and stability. Complete details on request.

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Marmy's Mailbox

'Tis here you exchange blasts with the old boy

FOOLPROOF BOILER?

Marmy told about a valve placed between the feed pump and a high-condensate-return tank. What's wrong with that? Nothing. ASME code calls for a stop valve between the check valve and the boiler.

We have valves on both sides of pumps to facilitate repair. But we have engineers as operators—not shoemakers. Even a low-mounted tank won't prevent water from going into a boiler when the boiler cools down over a long weekend. Vacuum then draws water into the boiler. I've seen it happen. But Marmy is good.

M HUIKKO *Litchfield, Minn.*

EDITOR'S NOTE: Marmy found no fault with the valve, but with the way the operator jammed the low-water alarm so the fuel pump would keep running until the boiler was ruined.

DID MARMY PAINT ICE?

I was especially intrigued by Marmy painting ice with lampblack and oil up in Alaska so that the sun would melt the ice sooner and let his boat through Lake Labarge. Did that really happen? If so, I can use the idea here. Send me all the details.

B J ZUBRZYCKI *Arivida, Que.*

EDITOR'S NOTE: Sir, how can you question anything Marmy says? He melted a channel through the ice three weeks before the spring thaw, just as he says. If you have any doubts, write the White Pass & Yukon Route people in Whitehorse, Yukon, Canada. They'll back him up. Marmy is *always* right.

STARTED ARGUMENT

Story in March 1956 about getting a fish line through the conduit is a corker. Two of our boys got into a hassel about the difference between a weasel and a ferret. Last time I visited the drafting room the argument was still going on.

L MCWILLIAMS *Shawinigan Falls, Que.*

GOOD FOR A LAUGH

I either get homesick for a rust-bucket ship or have a bellyache from laughing at Marmy's stories. And, at times, I learn something from them. Marmy and George Edwards are two features I always read in POWER.

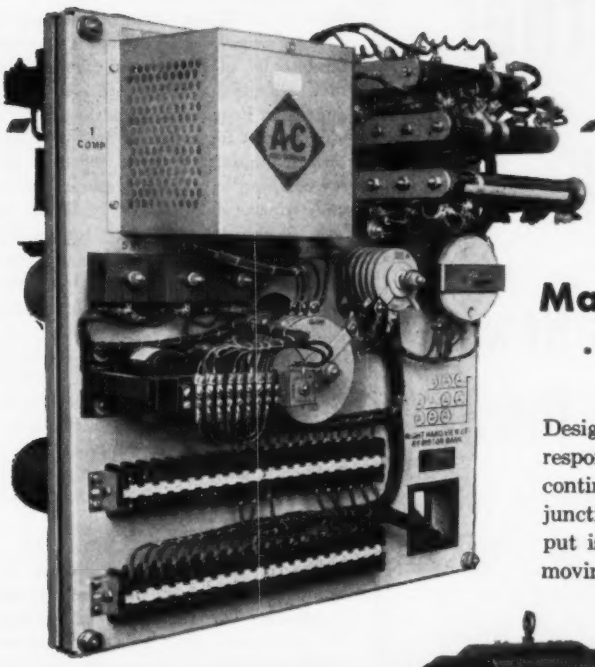
J T KENNEY *Penns Grove, N. J.*

Small?

Medium?

Large?

A size and type for your specific needs



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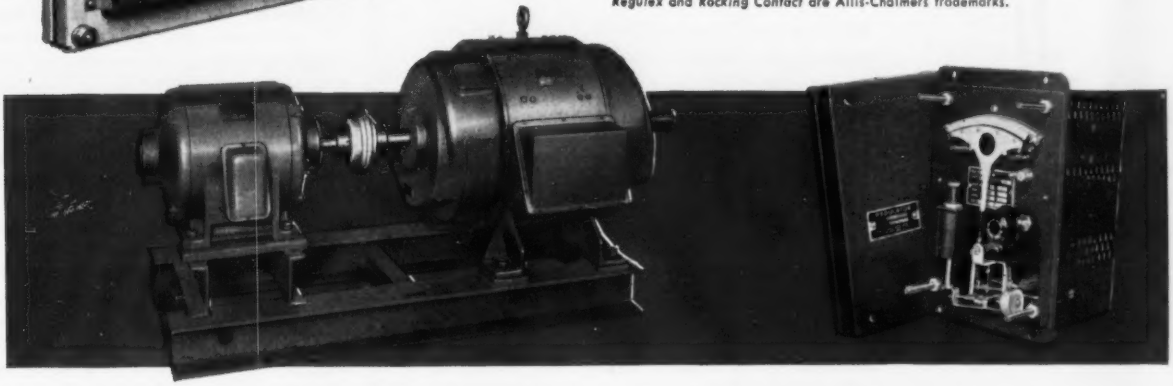
Magnetic Amplifiers
...high sensitivity
...low maintenance

Designed for applications requiring high sensitivity and response, where regulator is subjected to shock, or where continuous performance is a prime factor. Used in conjunction with *Regulex* unit when reversed polarity output is required. Since the magnetic amplifier has no moving parts it requires little maintenance.

Regulex and *Rocking Contact* are Allis-Chalmers trademarks.



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- Stability during high power-factor operations.
- Increased operating limits through automatic minimum excitation.
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For complete answers to any regulator problem, call your A-C representative, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

Rocking Contact Regulators for voltage regulation of smaller ac and dc generators.

- Varies resistance in exciter shunt field by rocking action of contacts.
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- No vibrating or sliding contacts to wear.

ALLIS-CHALMERS

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Meet the "Little Brother"

. . . he's New in the Warren family

Across the page . . . we present little TS*, the latest addition to the popular line of Warren Screw Pumps.

Like his big brother, IGAB**, he'll lift any noncorrosive liquid—up to 450 lbs. (IGAB goes about 1200 lbs.) And TS is ideal for *heavy* fuel oil services.

He's easy to take care of, too . . . like replacing the rotor by simply sliding a new one through the rear head. No adjustment is necessary.

And best of all—TS will do the job for half the price!

When you have a problem that can be handled by a smaller pump, consider this efficient little Warren TS. It saves on costs, takes up less space, is easy to maintain and guarantees the same pumping satisfaction of all experience-rated WARREN PUMPS.

*Twin Screw
**Internal Gear And Bearing (Quadruple Screw)

WARREN

WARREN PUMPS, INC., Warren, Mass.

G-5

CONVEYOR BELT

Continued from page 126

stands or long brackets. However, not everyone agrees that this is worthwhile. You must sacrifice some protection to be able to inspect belts easily. With the newer ideas about protective and supporting structure, and with ample clearances, it may become less important to see the return strand.

HEAD PULLEYS

Head pulleys account for as much trouble as return idlers. Accidents at a point where belt tension is greatest tend to be of more consequence. See that all pinch points are adequately guarded. Provide good, strong, removable guards for the head and snub pulleys. Eliminate the need for head-pulley cleaning by providing proper sprays and wipers on the underside of the belt before it runs over the pulley. Also, use good, flexible lagging. Good lagging on all pulleys cuts down build-up. If build-up persists, remove it mechanically.

In extreme cases, wash the underside of the belt before it runs over the head pulley. This should only be done when very fine material collects on the underside, with enough moisture present to make belt more slippery than if it were clean and wet.

OTHER ITEMS

The locations discussed above account for 94% of all our conveyor-belt accidents. The remaining components of, and attachments to, a belt, such as trippers, stackers, etc, account for only 6% of the accidents.

Here are some other items that deserve attention.

(1) Install starting signals to warn men of an imminent move. Signals should be audible along the entire belt length and under all operating conditions.

(2) Pipe grease fittings out to the edge of the deck for convenient lubrication.

(3) Provide for vulcanizing. Handle equipment for this job with hoists. Provide adequate working space with efficient ventilation and comfortable footing. Designate a regular vulcanizing station for each belt.

Don't clean belt with carbon tetrachloride. *Remember:* All petroleum base products are flammable and explosive. Chlorinated solvents may be cumulatively poisoning, must be handled carefully.

(4) Take care in moving and handling rolls of belting. This is always hazardous.

(5) Install probes in chutes, to shut down belt if a chute gets plugged. Ex-

CONVEYOR BELT

Continued from page 202

periment to find the answers about locations and dimensions.

(6) Install "wander" switches to sound an alarm or shut down the drive in case belt wanders off the bed and endangers its edges. "Plugging" switch installations prevent burning a belt on the head pulley.

7.) As far as possible, mechanize cleanup and eliminate manual handling.

See illustrations, pp 124, 125, for information on lighting, handrails, belt guards.

BEARING TROUBLE

Continued from page 121

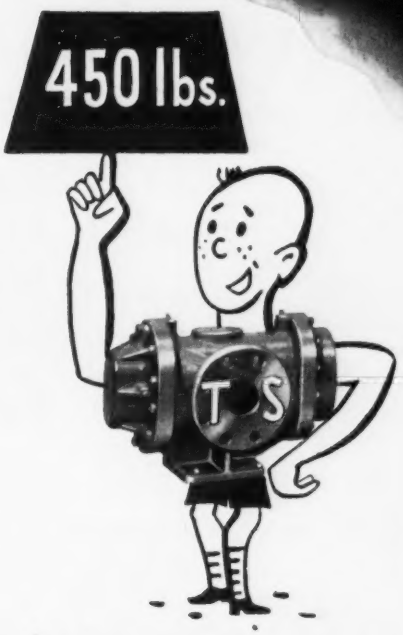
and shaft to prevent relative motion between the two. An oversize shaft will distort the inner race. The outer race will rotate in an oversized bearing housing. So be sure to check shaft diameter and the bearing housing diameter—and keep them within the limits set by the bearing manufacturer. An undersize shaft can be built up by metal spraying and grinding—but do it with great care. Prick punching the shaft or knurling it to raise metal and make-up for an improper fit is dangerous and definitely *not recommended*.

Two methods are used to mount ball bearings on a shaft. (1) Heat bearing to expand inner race and shrink it on the shaft. (2) Force bearing onto the shaft.

The heating method is safest. Use an oil bath or electric oven to heat the bearing to a uniform temperature of 200 to 250 F. Then quickly mount on the shaft, lightly tapping the inner race with a pipe as necessary.

The force method is best applied with an arbor press. Put a solid or split ring under the inner race to apply the force to the inner race only. Another less desirable way is to hammer alternately on opposite sides of a tubular sleeve held against the inner race. Extreme care is a must. You can ruin your bearing if you cock the bearing race or put pressure on the outer race. After mounting use a feeler gage to make sure bearing presses against the shaft shoulder.

Sleeve bearings. With babbitted sleeve bearings, the clearance between shaft and bearings should not exceed 150% of original clearance. Babbitt bearings can be restored by metal spraying, but the procedure is hazardous. If field repair is called for, rebabbitt by pouring. Use an undersize shaft as a core. Then give a final scraping for correct size. Take care



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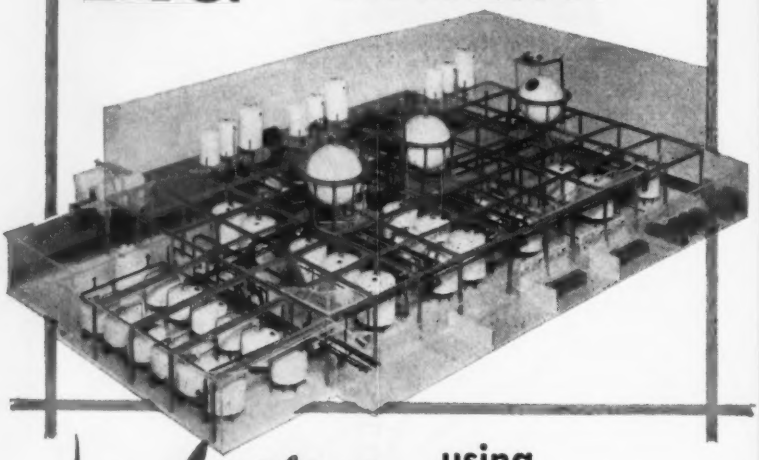

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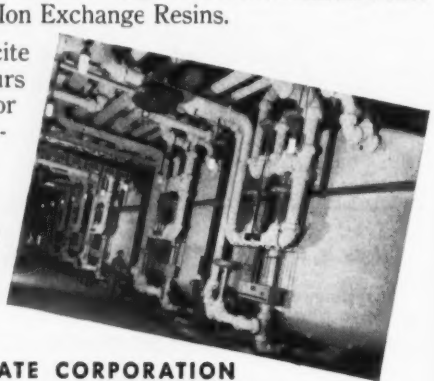

The model grows up. Section of demineralizer plant modeled above—one of world's largest—showing some of automatic control features.

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When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

BEARING TROUBLE

Continued from page 203

to locate oil grooves for good oil distribution.

Since bearing maintenance is vitally important to successful continuous operation, you may want to call on bearing manufacturers for advice. Their experts can give your maintenance crews required instruction.

EDITOR'S NOTE—For more details on bearing damage refer to manual entitled *Interpreting Service Damage In Rolling Type Bearings* published by The American Society of Lubrication Engineers, Chicago, Illinois. Copies are priced at one dollar, each.

My biggest boner

Some time ago, when relieving another operator at midnight, I found him busy trying to remove an 8-in. pulley from a 15-hp electric motor. Motor was driving an air compressor by a perpendicular drive. Operator had the key out and the belt off, but that's all he could show for almost 6 hr labor. There was no room for a wheel puller. Most of us know how impossible it is to drive these pulleys off without one.

I made a few bright, and not so bright, suggestions. But he had tried them all. Finally, I proposed we put the belt on, start the motor and see if she would work herself loose. My partner put the belt back on and I manned the switch.

"All set?" I yelled.

"Let her rip," he retorted.

Well, she ripped. The pulley flew off and in a hurry. Nearly killed both of us. *Moral*: Always keep control of your equipment.

H STEIN *Port Arthur, Ontario*

More ARGUMENTS

Continued from page 144

level executives to convince them that efforts in outside consulting work are very broadening. and increase your value to your employer.

As long as the engineer performs his assignments diligently and does not permit his outside interests to interfere with his regular work, there is no reason why he cannot do what he wishes with him own time.

On the other hand, engineering ethics do not permit a man employed by a

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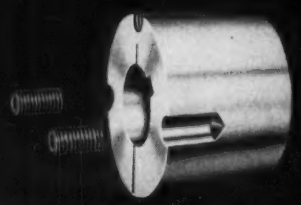

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More ARGUMENTS

Continued from page 204

company and paid a regular salary to engage in a private consulting business in direct competition with other consultants making their sole livelihood in the same professional endeavor. But if the three ambitious engineers are engaged as consultants in a specialized field in their area, they are free to offer their services in that field.

H SAWYER, JR, *Honolulu, Hawaii*

Three important questions. Are the three engineers free of debt, with the exception of their homes? Do they each have a thousand dollars in the bank? Are their respective wives willing for them to take the leap—and to go along with them if the going gets tough?

If they can answer "yes" to all three questions, they should quit their jobs and get going. If "no," especially to the first question, they should forget it. Anyone with no money to back him, and his pay check spent before he gets it, does not belong in his own business.

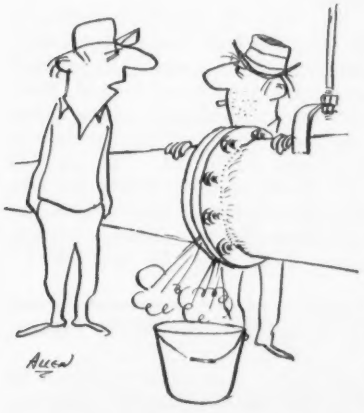
Here are some tips if they make the leap: Line up jobs as far ahead as possible. Get an office as cheap as is decent. Keep the wives out of it.

Let me quote my late boss: "If a man's got guts and money, there is nothing he can't do in this country." Are the three engineers in this class?

G ROSEKILLY, *San Mateo, Calif.*

When can you relax? I don't think holding two jobs at one time pays. You get some extra cash, but when can you relax? I would either quit my present job and form the company, or stay on the job and take only an occasional outside project.

C LONG, *Cowiche, Wash.*



"They don't want it fixed. We're supposed to run a line from the bucket to the condensate tank."

More TECHNICAL BRIEFS

Begins on page 158

tions are more favorable water will either have to be spilled, or at best, used to generate secondary power to be sold at dump rates, provided there is a market for it. Substantial economic gains are frequently possible through "firming up" such secondary hydro power by a supplementary thermal plant. This may be true even where hydro power is relatively cheap compared to thermal power.

The paper analyzes to what extent it is economical to "firm up" hydro power through thermal plants in areas with different ranges of hydro, thermal plant and fuel costs. It also indicates where conventional steam-turbine plants and where gas-turbine plants are more economical for this purpose. *AIEE paper No. 57-218.*

Hydroelectric development on the North Fork of the Kings River. *By W R Johnson, D P Dinapoli, J B Cooke, Pacific Gas & Electric Co.*

Construction is now underway which will fully develop more than one mile of head on the North Fork of the Kings River. Two high elevation dams (Courtright and Wishon) will provide 230,000 acre feet of storage. On a design flow of 760 cfs there will be a total power output of 296,000 kw from three plants (Haas, Balch, Kings River) scheduled for completion in 1959-61.

The project will include the installation of the largest vertical-shaft impulse turbines in the U.S.; an underground powerhouse; a high-head penstock crossing under the river; two high rock fill dams; unlined pressure tunnels; and automatic operation of the chain of plants. *AIEE paper No. CP 56-785.*

Pump/turbine Unit 2 addition at TVA Hiwassee hydro plant. *By L R Sellers and J E Kirkland Jr, Tennessee Valley Authority.*

The Hiwassee Dam, located in the southwest corner of North Carolina on the Hiwassee River, is well-suited for pumped storage development. The lake formed by Apalachia Dam backs up to the Hiwassee powerhouse and provides about 8700 acre-feet of water for pumping. This is equivalent to about 27 hours of pumping at rated pump capacity.

A thorough study of the benefits from installation of a pump/turbine unit as compared with the addition of a conventional turbine indicated that a satisfactory return on the 26% additional installed cost of a pump/turbine would be realized because of the increased on-peak energy and generating capacity

Directions for ordering papers on page 218

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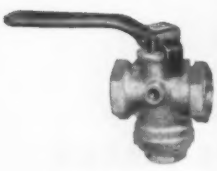

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More TECHNICAL BRIEFS

Begins on page 158

available. There may be additional intangible benefits, such as increased flexibility of system operation and maintenance of higher heads at other plants.

Paper describes the pump/turbine, the generator/motor design, and goes into operation of the unit. *AIEE paper No. 56-145.*

Fuels

Evaluating coal by utilization cost. *By W H Attwill and C E Day Jr, E I duPont de Nemours & Co, Inc, and A J Johnson.*

The basic objective of a well-designed fuels engineering program is to set up procedures by which the plants served can be supplied continuously with satisfactory coals to produce power at minimum cost. The authors demonstrate how such a program has been applied by the duPont Company, and the savings achieved.

While many factors contribute to the favorable results, the most important is the principle of "utilization cost." This means that the coals considered are evaluated on a basis of their actual worth at the point of firing. Full consideration is given to such factors affecting steaming costs as Btu, moisture, ash, grindability (in pulverized plants) and fine coal content (in spreader-stoker plants). *ASME paper No. 56-A-211.*

Competition, substitution and demand among fuels. *By P W McGann, U.S. Bureau of Mines.*

Economic factors must necessarily be considered in evaluating any proposed engineering application. This is especially pertinent in view of large, conjectural developments such as atomic power.

One type of economic relationship that has not been used as much as it should in this connection is empirical measurement of the fuel demand. Probably this is due largely to the inconvenience faced by individual analysts in developing such data. The work is often foreign to their primary interests. This paper provides some preliminary and illustrative data on these relationships. *ASME paper No. 56-A-189.*

Discussion of dust suppression in coal handling. *By I M Fisher, Johnson-March Corp.*

Coal dust in a power plant can be controlled effectively with a liquid system throughout the coal-handling oper-

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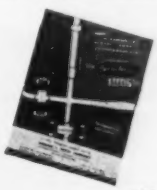

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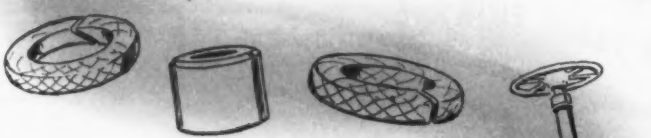

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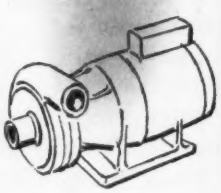

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Begins on page 158

ation. The possibility of fire and explosion is reduced to a minimum. Coal-dust cleanup time is reduced. The dust nuisance in the plant and community is eliminated. Savings are made through the prevention of stockpile windage loss.

This paper describes the methods of introducing surface-active agents into water and applying the resultant solution to the coal with a minimum of cost and effort, and a maximum of control and effectiveness. *ASME paper No. 56-A-212.*

The techniques of coal blending in the Japanese coking industry. *By Matake Kurokawa and Taizo Kuroda, Japan.*

Coke production in Japan in 1954 totalled 6,595,000 tons, of which blast furnaces consumed 3,181,000 tons and iron foundries 347,000 tons. Blast-furnace coke is generally manufactured by blending 35 to 65% of low- and/or medium-volatile coking coal, mostly imported from the U.S.A., with indigenous high-volatile coking coal; for foundry coke manufacture, 20 to 35% of anthracite is blended in addition to 10 to 25% low- and/or medium-volatile coking coal.

The production of metallurgical coke from indigenous coals alone has also been carried out by blending such low-volatile carbonaceous matter as semi-coke or petroleum coke with high-volatile coals with excessive bitumen, which tend to give friable, fingery coke if coke is unblended; or by adding "bojuntan" or coal-tar pitch to coals of insufficient caking power. *WPC paper No. 18C1.*

Progress of coal treatment in Japan. *By Matake Kurokawa, Resources Research Institute.*

Japan is endowed with relatively rich resources of coal which is the major source of energy for her industrial activity. Japanese coal, however, has very particular characteristics in that it is young and has been affected by geological processes. This confirms the fact that foreign techniques for the utilization of Japanese coal cannot always be applied with success. It follows that researches on the fundamental properties of Japanese coal are most essential for the development of her coal industry.

The author describes recent progress achieved in the coal-processing industry in Japan, with particular reference to the work accomplished by the Government Resources Research In-

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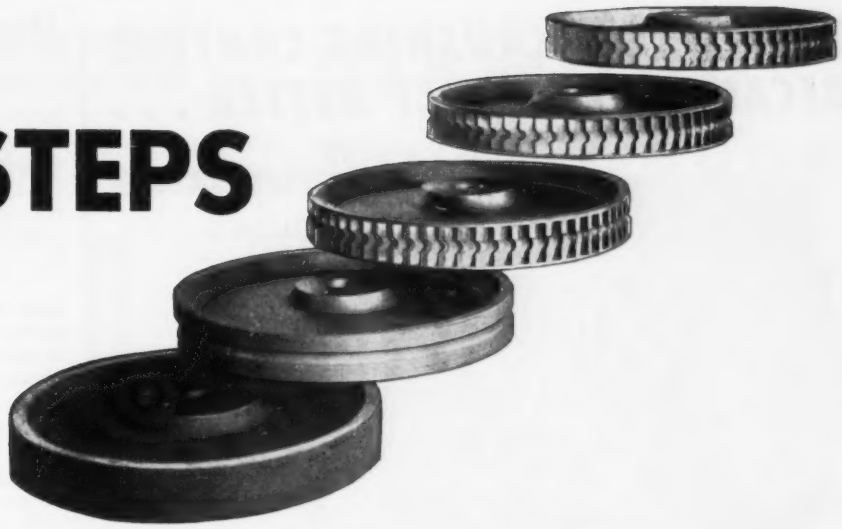
5 STEPS



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The rotor of a Terry solid-wheel turbine is a single forging of special composition steel. It is first rough turned in two operations, as shown, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or wear out.*

Blade wear, which might occur after many years of usage, is not important, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

The blades can't foul. They have a one-inch clearance, and are further protected by the projecting rims at the sides of the wheel.

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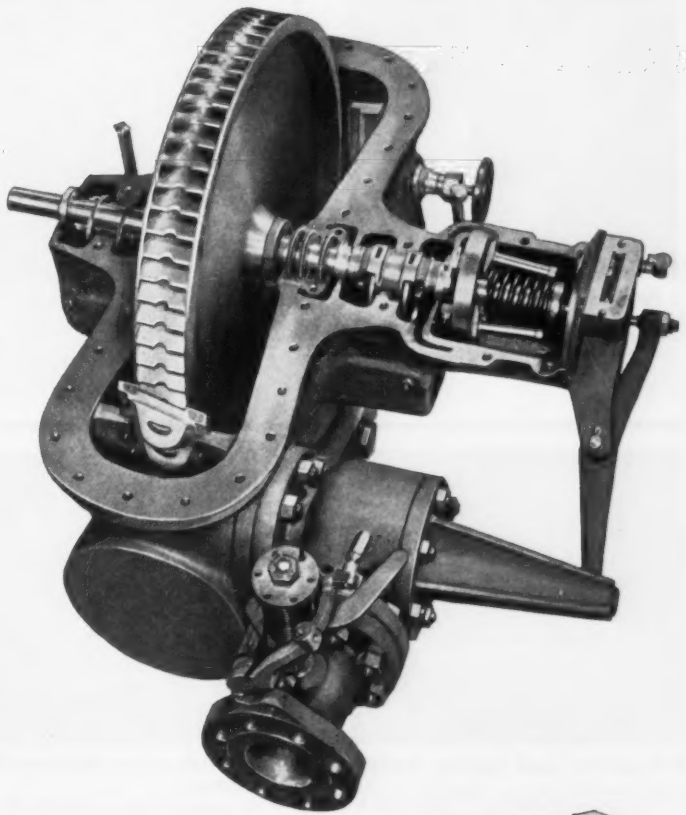

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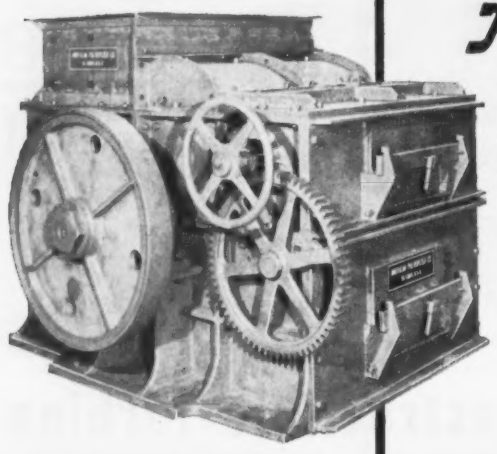
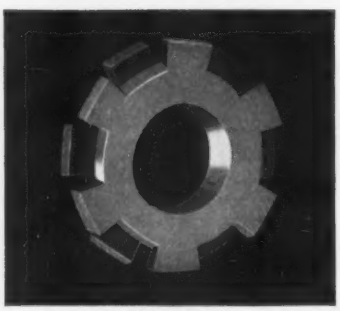
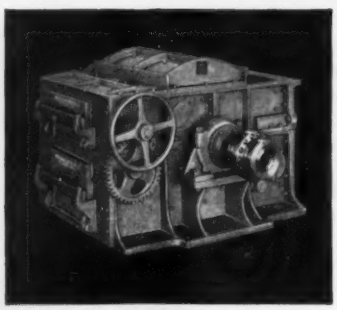




1 Patented Shredder Ring

American-originated feature that splits coal instead of smashing it—for uniform sizing, minimum fines. Result: Americans run at slow speeds, with savings in power and maintenance. No cams, shear pins, toggles.



2 Heavy-Ribbed Steel Frame

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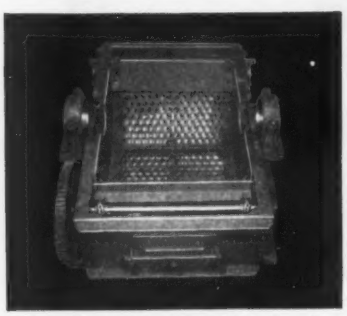
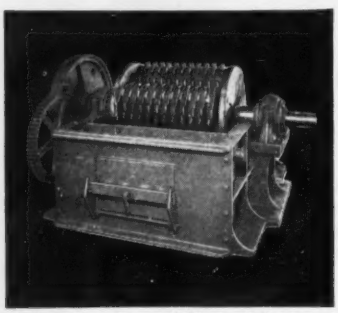


3 Completely Lined Crushing Chamber

Heavy, renewable liners . . . sectional for easy plate-at-a-time replacement . . . engineered to offer life-time protection to the frame.



4 Complete Accessibility to Adjustment and Parts

All adjustments external—even with crusher in motion. Rotor easily reached by removing top section. Rings readily reversed or replaced. Liners quickly reached, too, for periodical inspection.

WRITE for Coal Crushing Bulletin

American PULVERIZER COMPANY

Designers and Manufacturers of Ring Crushers and Pulverizers

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More TECHNICAL BRIEFS

Begins on page 158

stitute. Results of petrographical examinations, together with physical and chemical investigations of coal, are outlined. Progress made in the preparation of coal, both dense media and flotation, is summarized. *WPC paper No. 19C2.*

Some economic aspects of coal production and utilization in the Union of South Africa. *By Fuel Research Institute of South Africa.*

Bituminous coal is by far the most important source of energy in South Africa. The geographical distribution of coal-fields on the one, and of large consumer areas on the other hand is such, however, that most of the coal must be transported by rail over distances ranging from 80 to over 1000 miles.

The pit-mouth price of coal has been controlled by the Government since 1943, and has risen comparatively slowly. Most of the coal is marketed by cooperative selling organizations whose distribution charges are very low. Railage, however, affects the costs of coal to the consumers appreciably. In recent years coal shortages have been experienced, mainly because of transportation difficulties.

The effect of these factors on consumers and producers are briefly discussed. It is indicated that while the coal industry has taken steps to upgrade coal and to satisfy consumer demand, action is limited by the present margin between revenue and expenditure, the former being controlled. These factors as well as lack of demand for certain types of fuel are also responsible for loss of usable fuel to dumps. *WPC paper No. 57C4.*

Some experiences of pulverizing coal. *By R L Brown, and T F Hurley, Great Britain.*

In view of the increasing consumption of pulverized coal in Great Britain it is important to know whether the ease with which British coals can be pulverized can be related to their rank. It is necessary also to know whether a specially devised laboratory determination of grindability of a coal would be useful in predicting its performance in a full-scale pulverizer.

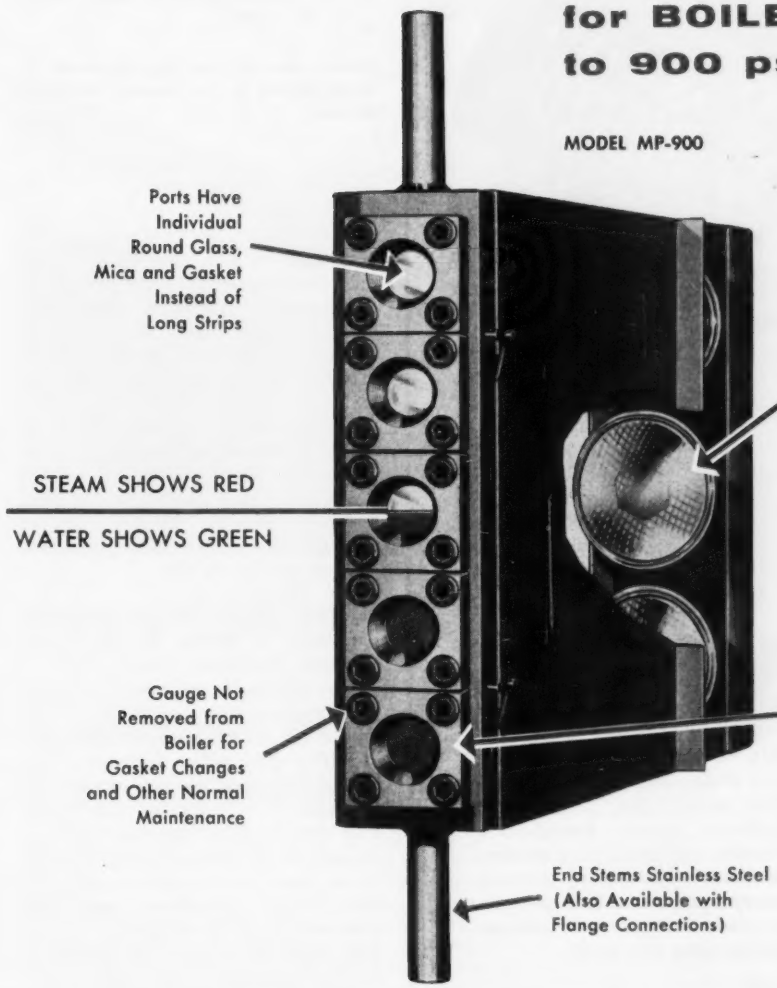
In the course of a laboratory study of the grinding process in two American grindability machines it was found that under certain specified conditions a reliable and reproducible grindability index could be obtained with either machine. Factors influencing the grind-

Directions for ordering papers on page 218

Sure-Reading ...DIAMOND "Multi-Port" Bi-Color Gauge

for BOILER PRESSURES to 900 psig

MODEL MP-900


Ports Have Individual Round Glass, Mica and Gasket Instead of Long Strips
"Sealed Beam" Lamps in "Hi-Lite" Illuminator
STEAM SHOWS RED
WATER SHOWS GREEN
Also available is Model MP-3000 for boiler pressures to 3000 psig
Complete Port Change and Cut Back into Service in Minutes Instead of Hours
Gauge Not Removed from Boiler for Gasket Changes and Other Normal Maintenance
End Stems Stainless Steel (Also Available with Flange Connections)

The individual round ports each having its own round glass, round mica and round gasket (instead of the conventional long strips) means less stress and strain . . . resulting in greatly reduced maintenance. When replacement is required, it is usually only one port . . . which can be changed in a very few minutes . . . and without removing the gauge from the boiler.

The Diamond Bi-Color feature is another important advantage of the MP-900 Multi-Port . . . steam always shows red and water always shows green. There can be no question of the water level.

Recommended for both new and old boilers up to 900 psig, the MP-900 Multi-Port will give you a new standard of gauge operation. Use the coupon below for additional information.

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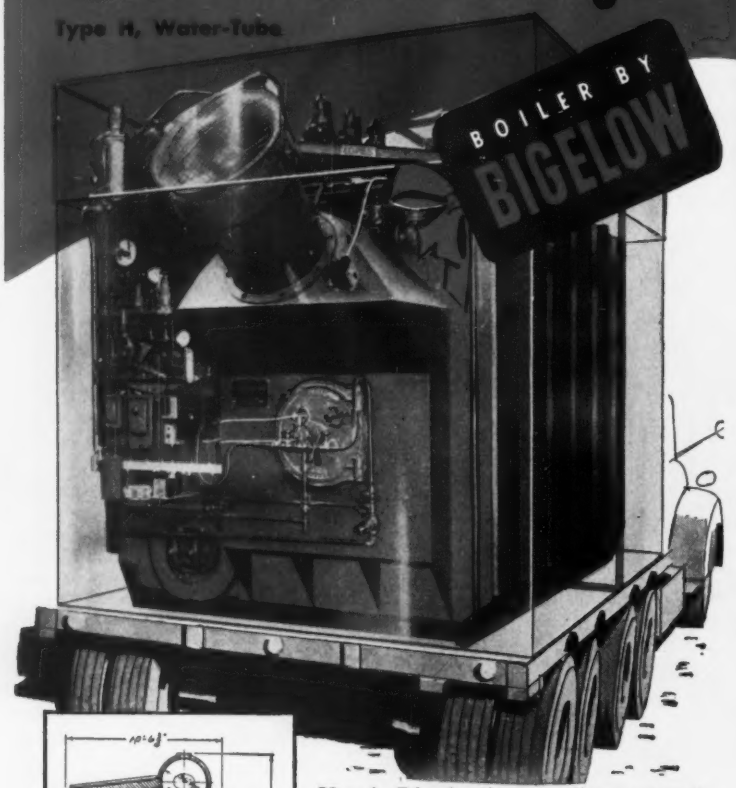
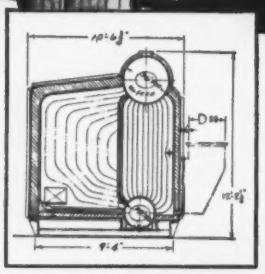
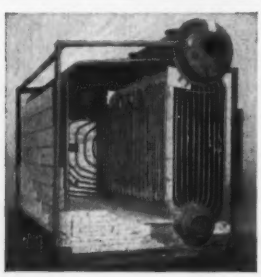
Type H, Water-Tube





Here's Bigelow's new, "one-piece" answer to a wide range of steam problems. This water-tube "packaged" boiler includes burner, forced-draft fan, feed water regulator, soot blower, valves, refractory, insulation, controls and accessory equipment. It is shipped complete—ready to operate as soon as service connections are made.



Type H boiler in process of shop assembly.

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B1-13

More TECHNICAL BRIEFS

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ability index obtained with the Hardgrove machine have been studied. Determinations with over 300 coals led to the conclusion that the indices of low-ash air-dried British coals are closely associated with rank. *WPC paper No. 116C8.*

Recent research and developments in Great Britain in the thermal treatment of coal. *By W Idris Jones, National Coal Board.*

This paper describes various processes that are being developed in Great Britain for making uniformly-sized smokeless briquettes from coking coals, both those of high and low rank. In this development, a novel process of carbonization, capable of being operated at exceptionally high rates of throughput, has been evolved, which may have application in the wider, general field of carbonization.

The findings of current research on the fundamentals of the coking processes, particularly on the relation between the fluidity of coal in the plastic state and the hardness of the resultant coke, are also described. *WPC paper No. 117C9.*

Potential resources of oil for future generation in Mexico. *By Ing Luis F de Anda, Geothermic Power Comm.*

The exploitable petroleum deposits of Mexico are estimated at 795 to 1430 million cu meters, by other quarters at 3180 to 6360 million cu meters. This amount should satisfy any possible demand in this country for a relatively long time to come. Petroleum fields are utilized in five main districts as well as in some less important zones. In 1953, total petroleum production amounted to 11.8 million cu meters, from which 11.4 million cu meters of various oil-products were obtained.

Refining capacity stands now at 15.8 million cu meters per year. The cracking techniques in use are not the most efficient, but the existing installations are being improved and modernized. Much attention is being paid also to the extension of the pipelines-net for crude oil transport. About 90% of electricity generation by thermic plants is based on petroleum; favorable oil prices help to displace coal on the national market. *WPC paper No. 159A25.*

Oil as a factor in future energy supplies. *By O F Thompson, The Shell Petroleum Company Ltd.*

World economic progress may be expected to cause large increases in

Directions for ordering papers on page 218

COOLING TOWER DRIVES

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...easily meet the growing need for larger fans and higher load requirements

Modern Cooling Towers and air-cooled heat exchangers require reducer drives which are engineered for the job. Gears, bearings, housings and bearing supports must meet the severe and varied load requirements of today's heavier fans, higher speeds, increased air thrusts, and more extreme atmospheric and temperature conditions.

Fans should be designed for quick and easy mounting, directly on output shafts. Unit design should allow space for close coupling of motors where this is desired. Generous service factors are necessary to meet momentary overload situations. Careful design for rigid alignment of all components, is important to assure proper installation, and long, trouble-free service life. Lubrication systems must insure maximum protection with a minimum of maintenance.

To meet these stepped-up, modern requirements, Phillie Gear has designed a new series of bevel, spiral-bevel and worm gear cooling tower drives. Each is built for a specific type of service, and is available in a complete range of sizes and capacities.

Phillie Gear Cooling Tower Drives are in service around the clock—all over the World. For complete details please request Catalog CT-561.

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- **High dome permits mounting fan directly on unit, with ample clearance below fan blades.**
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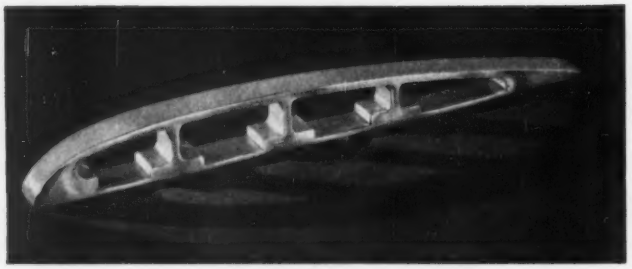

Cross section shows structural superiority of Aeromaster's new, extruded aluminum-alloy blades in diameters from 9′ to 22′.

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AEROMASTER'S new, extruded aluminum blades combine in one design the advantages of a light weight metal, a hollow structure and the superior strength of wrought metal . . . Silicon-magnesium aluminum alloys resist corrosion. Their fine grain structure, high tensile strength and increased endurance limit eliminate danger from wear, vibration, and metal fatigue . . . true airfoil blade sections assure maximum air delivery . . . adjustable blade pitch angle permits decrease of fan load to an accurate minimum horse-power requirement.

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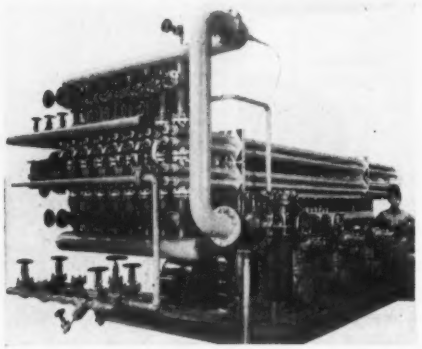

Photo shows one of two, High-Pressure (1000 PSIG) Units being furnished for a Public Utility in the Southwest . . . 3 electrically-driven screw pumps and multiple arrangement of Griscom-Russell Twin G-Fin Heaters handle 230 GPM of heavy fuel oil. Equipped with: Strainers, Temperature and Pressure Controls.

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More TECHNICAL BRIEFS

Begins on page 158

the demand for energy over the next twenty years. This paper discusses the future outlook for world energy needs in the light of economic developments in both the highly developed and the less developed areas. It describes the growing importance of the contribution of oil as an energy source.

By 1975, the oil industry may have to supply over twice the amount of oil now being consumed in world markets. The industry will be called upon to perform a service which will involve expenditures and development activities on an immense scale. It is important that the nature of the task, and the conditions necessary for its accomplishment, should be fully recognized. *WPC paper No. 168A29.*

Steam plants

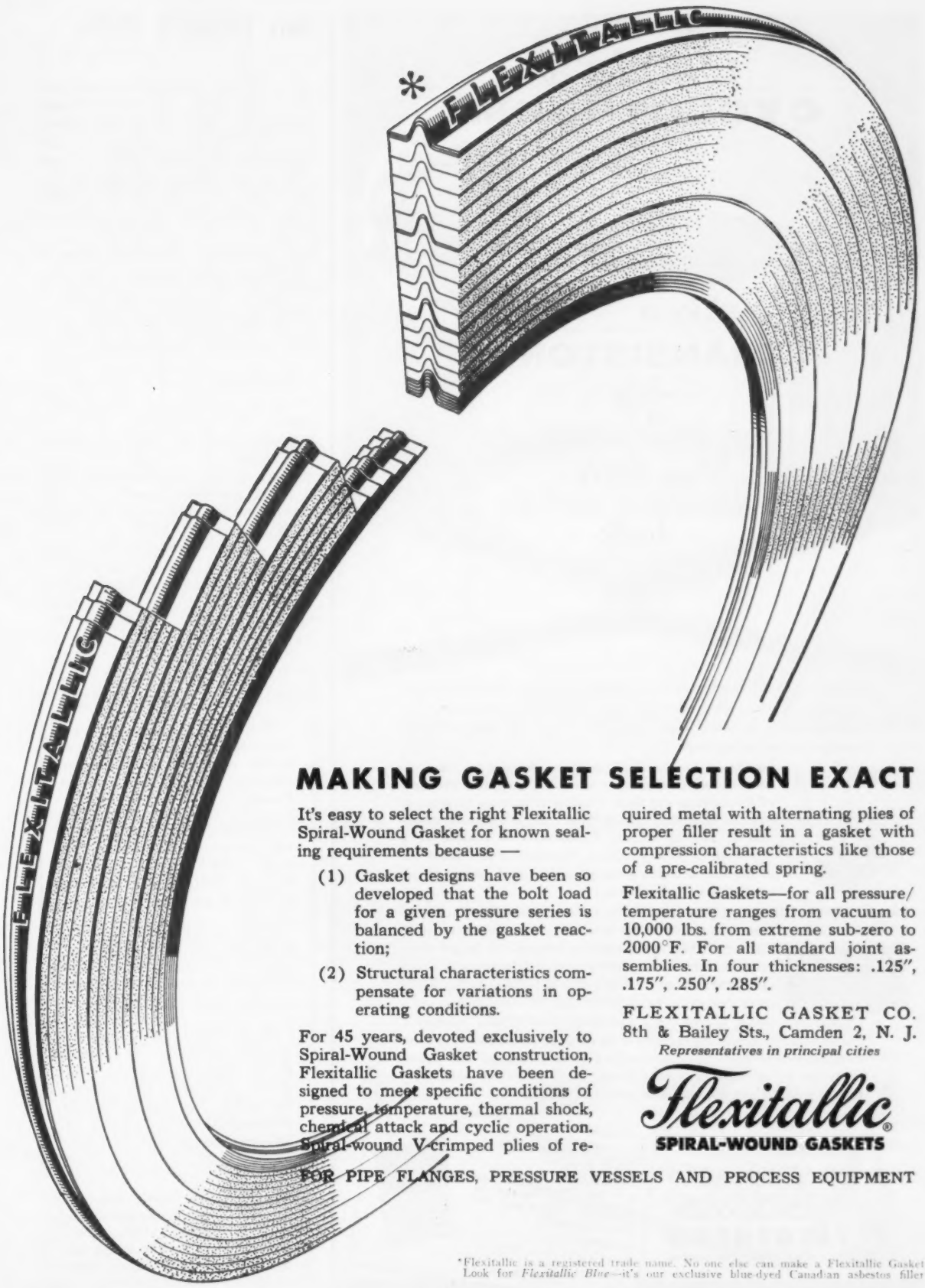
Refinements in design of steam-electric generating stations. *By J L Cohon, Southern California Edison Co.*

With the growth of the Southern California Edison Company system, the relative importance of an individual plant decreases proportionately. Likewise, dependability of the system as a source for auxiliary power increases. It follows that provision of special sources of generation for station auxiliaries is no longer considered necessary. Also, when considering equipment for use on standby service or as spares the quantity involved can be restricted to an amount or size sufficient for one unit's replacements, as long as this equipment is arranged for common use between units or stations. In certain cases selection of spare or standby equipment may be based primarily on maintenance requirements. Since the capital saving that may be realized under this system is considerable, it is important to weigh carefully these considerations in future planning. Not to be overlooked is the continuing improvements in design and types of materials developed in research by manufacturers. Full advantages of these factors should be taken when determining spare part requirements and the necessity for duplicate auxiliaries or services. *AIEE paper No. 56-771.*

First commercial supercritical-pressure steam turbine—built for the Philo Plant. *By C W Elston and R Sheppard, General Electric Co.*

This paper describes the essential design features of a 125,000-kw 3600-rpm tandem-compound double-flow

Directions for ordering papers on page 218



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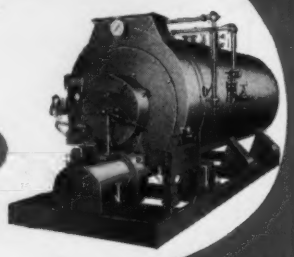
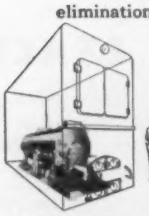
why is a CYCLOTHERM



like a TRANSISTOR?

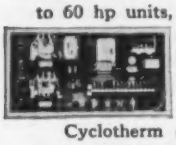
...They both eliminate useless bulk

COMPACT—that's the word for today's radio, with modern transistor tubes replacing the big tubes of earlier days. And Cyclotherm, too,—the modern steam and hot water generator—is a case history in the elimination of useless bulk.



Saving up to one-third the space required by the ordinary boiler, Cyclotherm's exclusive, patented Principle of Combustion and Heat Transfer gives more horsepower per unit of weight, uniform heat transfer for every square foot of heating surface. Guaranteed to operate at a minimum of 80% efficiency, Cyclotherm gets more out of the fuel it burns, gives you substantial savings in gas or oil and in maintenance.

AN ELECTRONIC CONTROL SYSTEM operates Cyclotherm automatically. On 18 to 60 hp units, burner shuts down when steam demands are satisfied, starts up when steam again is needed. On larger units, precision modulation keeps peak efficiency with boiler operating at from 30% to 100% of rated capacity. Many users report up to 50% savings in maintenance costs.



Cyclotherm comes to you fully assembled and factory pre-tested. Needs only five simple connections to be ready to go. Many plants have installed two or more Cyclotherms for greatest flexibility and power. Burns gas or oil with quick changeover. In 18 to 500 hp models, 15 to 200 psi. Fill out coupon below and mail today.

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More TECHNICAL BRIEFS

Begins on page 158

steam turbine designed for steam conditions of 4500 psig, 1150-F initial temperature, 1050 F at the first reheat, and 1000 F at the second reheat. The engineering objectives, problems, and solutions are emphasized more than the description of design details. *ASME paper No. 55-A-159.*

First commercial supercritical pressure steam-electric generating unit for Philo Plant. *By S N Fiala, American Gas & Electric Service Corp.*

The commercial success of higher pressures, higher temperatures, reheat, larger units and single-boiler, single-turbine unit designs has given customers of the utility industry cheap electric power. The Philo project reflects efforts to continue this trend by opening new avenues of approach. The engineering, design, manufacturing, construction and operating experience on the 120,000-kw steam-electric generating unit operating at 4500 psig, 1150-F initial temperature with double reheat (first at 1050 F, second at 1000 F) should provide the know-how to create units of still greater economy within the next decade. *ASME paper No. 55-A-137.*

TO OBTAIN COMPLETE TEXT

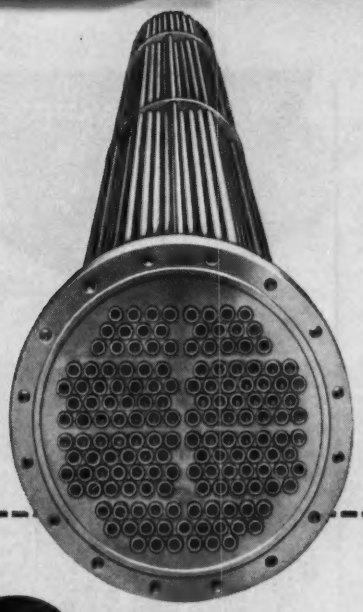
Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

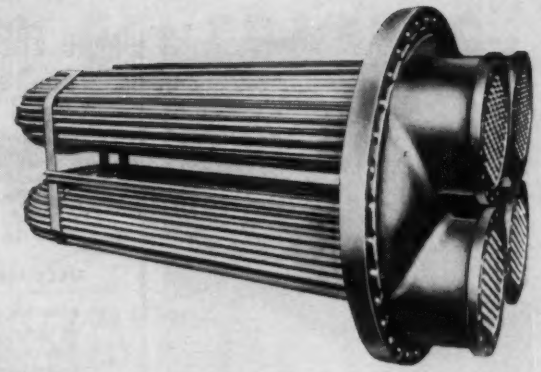
American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

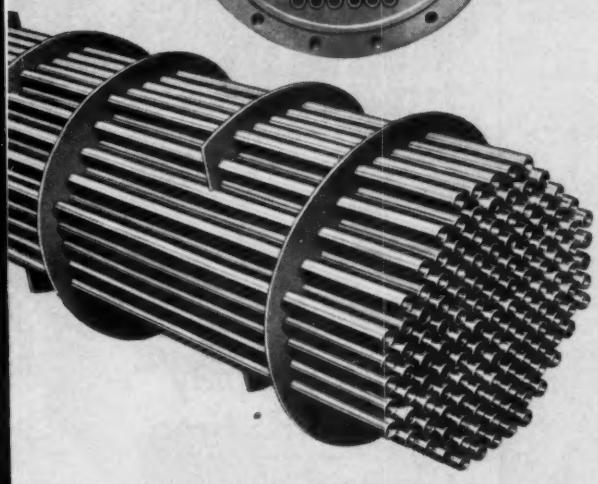
American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

World Power Conference, 5th meeting, identified by initials WPC. Information as to availability obtainable from Oesterreichisches Nationalkomitee der Weltkraftkonferenz, Vienna I, Schwarzenbergplatz 1, Austria.

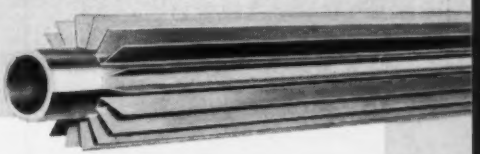
Scanlan-McMahon Assoc, Inc, a new firm of consulting engineers has established an office in Cleveland, Ohio. The firm plans to center its activity in the field of industrial steam power plants. Main office is 18724 Scottsdale Boulevard, Shaker Heights 22, Ohio.





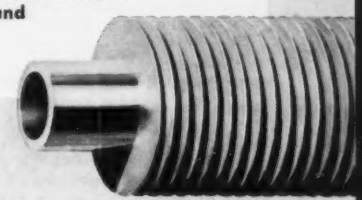


TWO GOOD WAYS TO ADD ADDITIONAL HEAT TRANSFER SURFACE AREA TO B&W CARBON STEEL ERW TUBES



(A) Longitudinal Channels Welded On

(B) Continuous Helical Fin Wound Around Tube and Welded On



TUBING REQUIREMENTS FOR HEAT TRANSFER EQUIPMENT

The economy and usefulness of pressure tubing in heat exchanger and condenser applications depend on the tubing's heat transfer ability and the ease with which it can be bent, coiled, swaged, and rolled into tube sheets.

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B&W Electric-Resistance-Welded Carbon Steel Heat Exchanger and Condenser Tubing is widely used in the process industries, including petroleum refining and chemical processing, and in refrigeration and steam generating equipment. If carbon steel tubing can do the job required, you will find B&W ERW Tubing provides maximum, trouble-free service life. For additional information, call on Mr. Tubes, your nearby B&W Tube Representative — *or write for Bulletin 412.* The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

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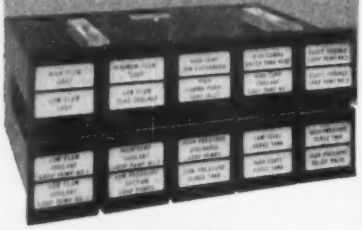

SCAM DU-ALL

(Patent 2,730,704)

Scam Model SC-10 DU-ALL annunciator systems introduce new standards for compactness, usefulness and economy. Available in four standard cabinet sizes with Scam's unique plug-in relays, plug-in light boxes with 2-section back lighted nameplates. Each plug-in and light box combination provides alarm indication for two separate and unrelated field conditions . . . Write or phone for information on your specific alarm problem.

ALARM SEQUENCE:

Normal: lights off, horn off
Abnormal: lights flashing, horn on
Reset: lights bright, horn off
Normal again: lights off, horn off

Features of the SC-10 MODEL

1. **Interchangeable with standard Scam systems.**
2. **Operates with normally open field signals.**
3. **Optional Lock-in of momentary alarms.**
4. **De-energized circuit (no-drain).**
5. **Photograph illustration above with 20 alarm stations requires panel area of only 7⅜" high x 17¾" wide.**
6. **Two lamps for each indication.**
7. **Economical.**

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More FREE LITERATURE

Begins on page 171

11 **Emergency lighting** units are described in 4-p bulletin 11-1957. Includes data on power systems, exit lights, hand lamps. Electric Cord Company, 195 William St, New York 38, N. Y.

MECHANICAL TRANSMISSION

12 **Flexible couplings** are described in illustrated 24-p catalog C 41-56. Dimensions and specs are given on standard, double and radial type units with further data on coupling driveshifts. Morse Chain Company, Ithaca, N. Y.

13 **Variable pitch drives.** Illustrated 12-p bulletin V-183-A contains specs, engineering info and tables of practical stock drive combinations for easy selection. Browning Manufacturing Company, Maysville, Ky.

VALVES, PIPING, FITTINGS

14 **Bronze valves.** Solder end and silver-braze end bronze valves in gate, globe and check designs are described in 4-p bulletin DH-25. R-P&C Valve Division, American Chain & Cable Co, Inc, Reading, Pa.

15 **Line pipe** and well tubing, made from thermosetting reinforced epoxy resins, is described in 4-p bulletin. Corrosion-resistant product operates within temperatures of −65 to 260 F. Fibercast Corp, Box 727, Sand Springs, Okla.

16 **Flare tube fittings.** Illustrated 52-p catalog 4310 presents line of fittings made in brass, steel, stainless steel and aluminum; all shapes including swivel-nut type and straight threaded fittings with O-rings for SAE straight thread boss. Parker Appliance Company, Tube & Hose Fittings Division, 17325 Euclid Ave, Cleveland 12, Ohio.

17 **Flareless tube fittings.** Illustrated 28-p catalog 4320 includes data on fittings for mounting in SAE straight thread boss using O-ring for sealing. Parker Appliance Co, Tube & Hose Fittings Division, 17325 Euclid Ave, Cleveland 12, Ohio.

18 **Steel tubing** and fittings for vacuum systems and conveying lines are described in 6-p bulletin V-157. Includes specs, diagrams, tables. H-P Products Inc, Louisville, Ohio.

PUMPS

19 **Industrial pumps.** Illustrated 20-p bulletin 5000 describes characteristics, materials of construction, types, sizes and capacities of six major types of pumps for the chemical process and related industries. Dorr-Oliver Inc, Barry Place, Stamford, Conn.

(*Continued on page 222*)

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Vogt STEAM GENERATORS

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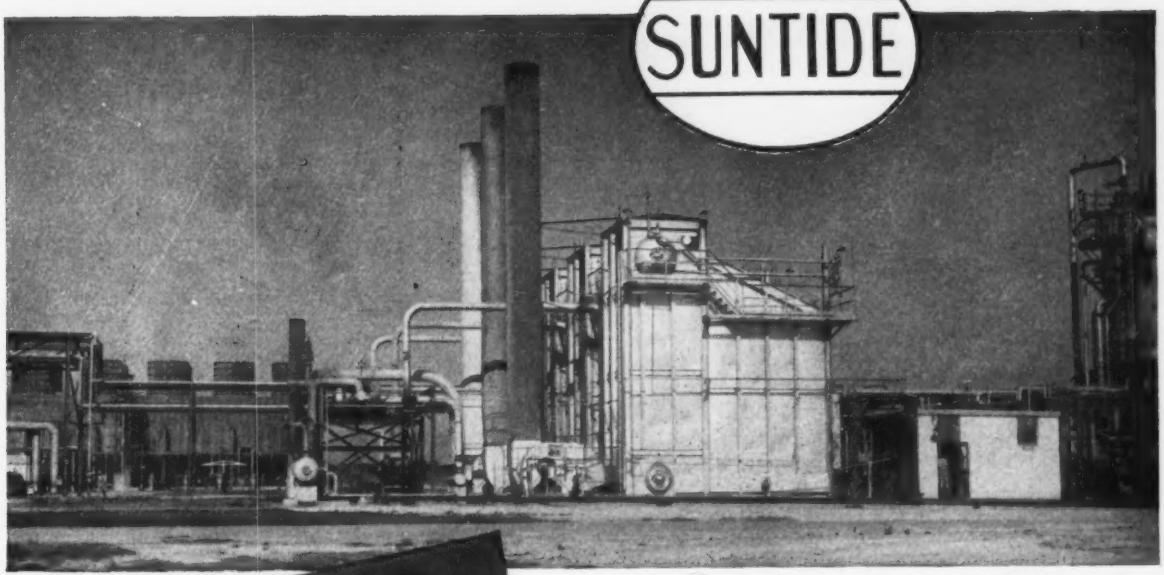
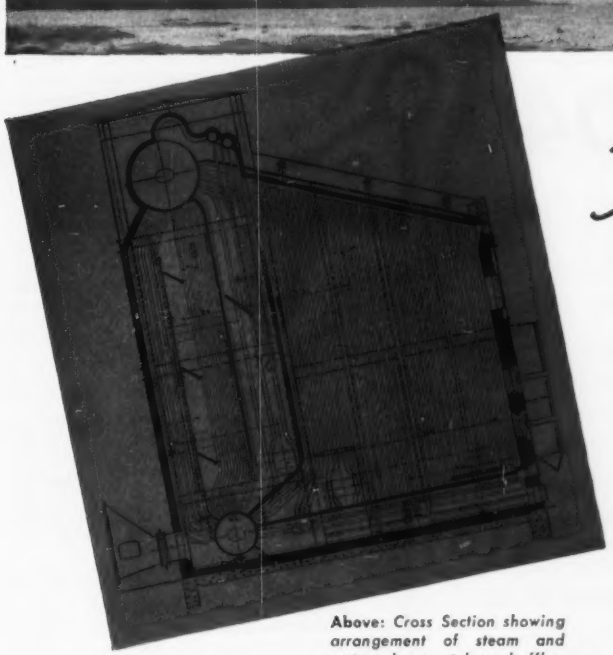
Viola, Texas





Above: *Cross Section showing arrangement of steam and water drums, tubes, baffles, and furnace.*

3 Units Installed
2 Units on Order

Principle Data Each Unit

- 85,000 pounds steam per hour capacity, designed for 500 lbs. S.W.P. and 625° F. total temperature.
- Water cooled furnace.
- Burners for Gas and Oil fuel.

Vogt offers a complete line of custom built and package type steam generators. Available in bent tube and straight tube designs for solid, liquid, or gaseous fuels burned singly or in combination.

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More FREE LITERATURE

Begins on page 171

20 **Close-coupled pumps.** Illustrated 12-p bulletin 1100 contains table for determining hp, capacity and head for vertical pumps. Also includes specs, sectional views, schematic application drawings. Layne & Bowler Pump Company, 2943 S Vail Ave, Los Angeles 22, Calif.

21 **Motor pump units** are described in 8-p catalog 107. Units are designed primarily for handling heavy fuel oils in industrial and commercial oil-burner service. Tuthill Pump Company, 939 E 95th St, Chicago 19, Ill.

22 **Controlled volume pump.** Bulletin 1056 describes and illustrates the construction of the sanitary liquid end and ease with which it is disassembled for cleaning. Milton Roy Company, Station F, 1300 E Mermaid Lane, Philadelphia 18, Pa.

23 **High-pressure pumps** for pressures to 35,000 psi and capacities to 2000 gph are described in 8-p bulletin HP-1254. Philadelphia Pump & Machinery Company, 13500 Philmont Ave, Philadelphia 16, Pa.

24 **Centrifugal pumps.** Six-page bulletin P-3b describes high-speed unit for handling clear liquids and fine slurries. Ampco Metal Inc, 1745 S 38th St, Milwaukee 46, Wis.

25 **Rotary pumps.** Illustrated folder 115650M gives thumbnail description of five internal gear rotary pumps. Wayne Pump Company, 212 Tecumseh St, Fort Wayne 4, Ind.

NUCLEAR ENERGY

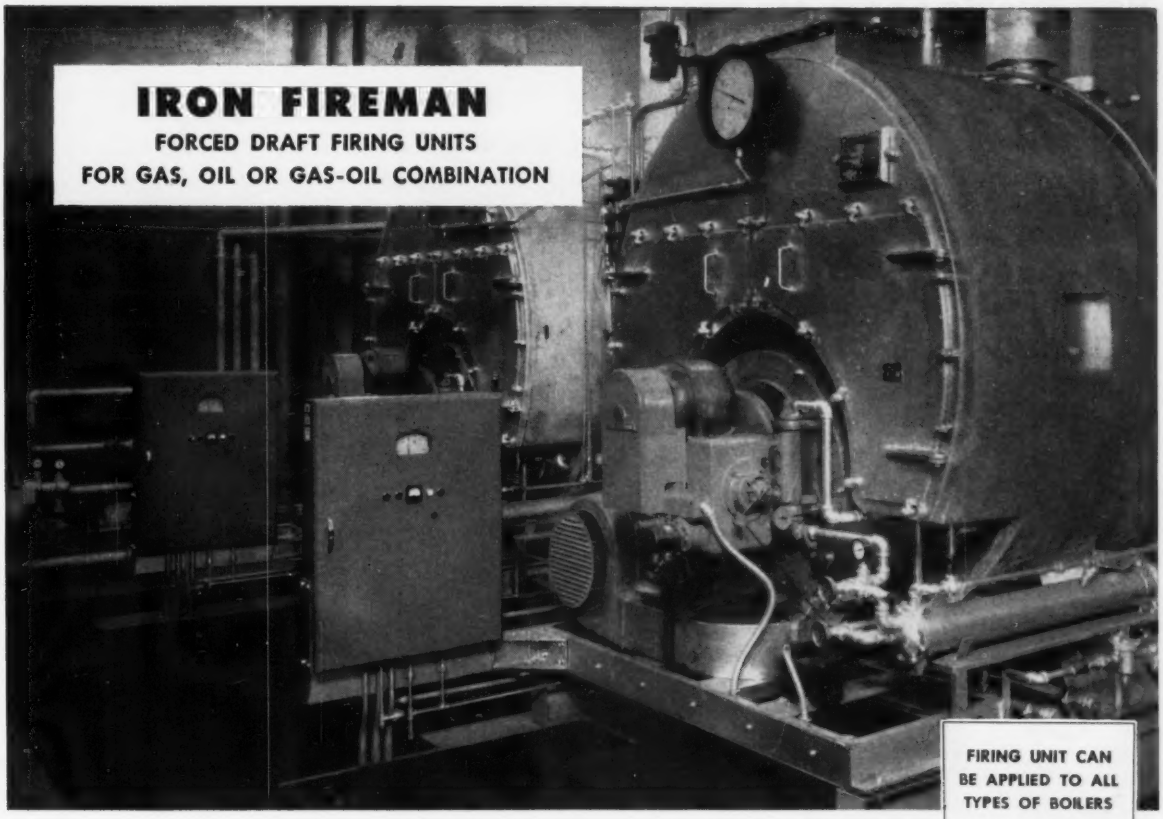
26 **"Rolling mills** for processing nuclear fuel elements" is title of 12-p bulletin. Discusses equipment used in rolling and fabricating metals needed for the atomic energy program. Stanat Manufacturing Co Inc, 500 Shames Dr, Westbury, N. Y.

27 **Dresden station.** Bulletin GER 1301 presents a detailed picture and word description of various phases of design work on the Commonwealth Edison Dresden nuclear power plant. General Electric Company, Apparatus Sales Division, Schenectady 5, N. Y.

28 **Tank-type** research reactor, bulletin N-56-9 and aqueous homogeneous power plant, bulletin N-56-8 are available from Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

29 **Swimming pool,** heavy water and nuclear test reactors are described in 12-p bulletin GEA 6326-B. Includes data on specific uses, design characteristics, safety features and experimental facilities. General Electric Company, Apparatus Sales Division, Schenectady 5, N. Y.

(*Continued on page 224*)



Typical installation of Iron Fireman packaged oil-gas firing units in Scotch type boilers. Illustrated are Kewanee-Iron Fireman boiler-burner units.

Here are features that Architects, Engineers and Owners appreciate

Easy to size and specify. After deciding on the fuel (gas, oil or gas-oil combination) and determining the required load, it is only necessary to refer to a simple chart to find the correct size of unit for your job.

Big reserve capacity. Boiler-burner units are conservatively rated. This means that the unit will carry its rated load at a comfortable "cruising speed." Maintenance costs are low, and high peak loads are taken in stride.

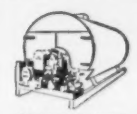
Economy. Installation costs are low. No special boiler setting; no intricate wiring (factory wired and tested control panel is part of the unit); no complicated piping; no on-the-job refractory work. Factory engineering throughout assures exceptional fuel economy.

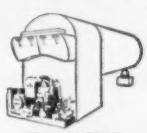
No high stacks—no high ceilings. Forced draft eliminates costly and unsightly stacks. Compact boiler requires little headroom.

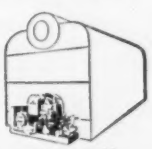
Firing unit fits all types of boilers. The Iron Fireman forced draft burner is a complete firing system which requires no firebox alteration, no pit for underfloor air, no ignition arch. Easily applied to new or existing boiler settings.

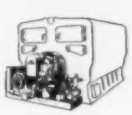
Send for catalog with specifications

FIRING UNIT CAN BE APPLIED TO ALL TYPES OF BOILERS


SCOTCH MARINE


STEEL FIREBOX


WATER TUBE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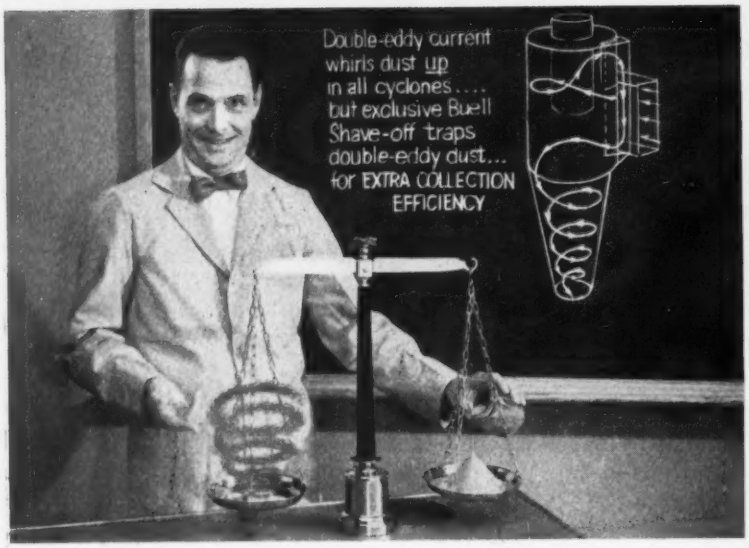
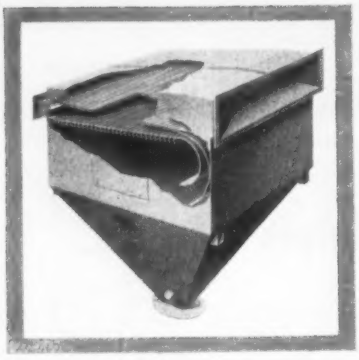
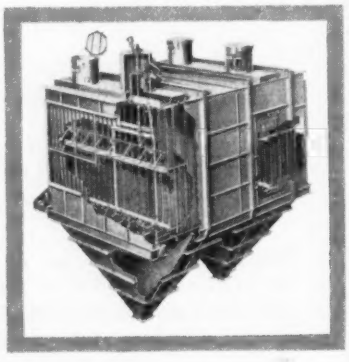
How Buell's Shave-off tips the scales for Extra Dust Collection Efficiency


Double-eddy current whirls dust up in all cyclones.... but exclusive Buell Shave-off traps double-eddy dust... for EXTRA COLLECTION EFFICIENCY



Side entry of dust-laden gases, through Buell-designed manifolds minimizes turbulence, raises efficiency even higher in Buell cyclones. Large-diameter design eliminates clogging and bridging. Heavy plate construction assures years and years of extra service life without repair or replacement.



Buell's Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for either natural or mechanical draft installations. Ideal for boilers from 100 to 2000 BHP.

SF Electric Precipitator, a Buell exclusive, also delivers *extra efficiency* due to unique Spiralectrodes and Continuous Cycle Rapping of collecting electrodes.

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Buell Engineering Company,
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MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in
DUST COLLECTION SYSTEMS

More FREE LITERATURE

Begins on page 171

MISCELLANEOUS

30 **Electric power plants.** Illustrated 12-p bulletin describes use of detailed precision scale models and other up-to-date engineering practices, with examples of projects undertaken. The Fluor Corporation, Ltd, 2500 S Atlantic Blvd, Los Angeles 22, Calif.

31 **Mechanical packings** for industrial, power and processing plants are described in illustrated 4-p bulletin. Flexrock Company, 36th and Filbert Sts, Philadelphia 1, Pa.

32 **Insulating products.** Illustrated 20-p catalog CS-105 lists standard sizes, thicknesses and thermal conductivities for more than 20 types of heat and cold insulations for equipment and piping. Includes temperature - thickness recommendations for each. Baldwin-Hill Company, 500 Breunig Ave, Trenton 2, N. J.

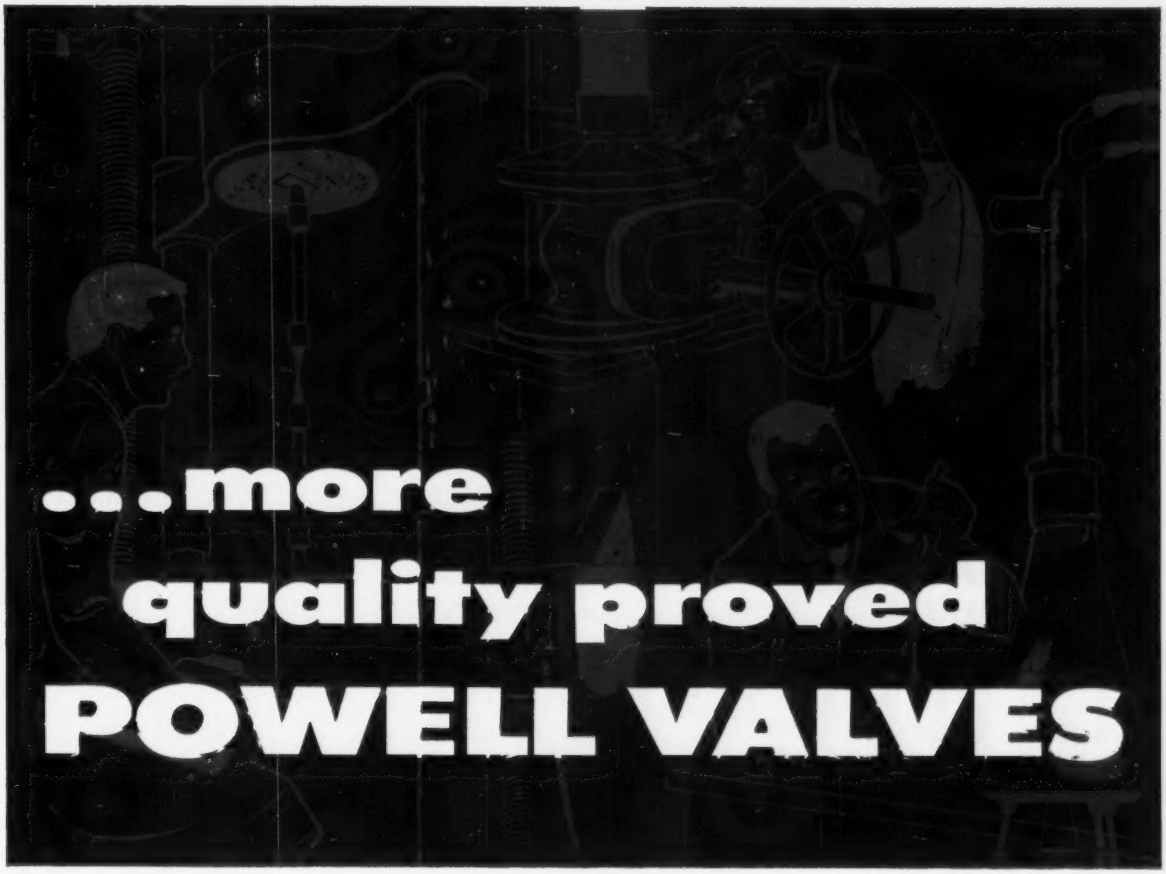
33 **"A guide** for selecting an engineering firm" is title of bulletin offered by The Teller Company, Group P, Butler, Pa.

34 **Silicone products** are described in illustrated 12-p reference guide. Groups products by usage—water-repellents, dielectrics, release agents, etc. Dow Corning Corporation, Midland, Mich.

35 **"Hydroelectric progress** in Canada, 1956" is title of bulletin 2551. Reviews current water-power developments throughout Canada and other construction pertaining to electrical power supply and distribution. Water Resources Branch, Department of Northern Affairs and National Resources, Ottawa, Canada.

36 **X-ray for industry** is title of 12-p bulletin RC-176. Contains operating and application data on six types of radiography units. Instruments Division, North American Philips Co, Inc, 750 S Fulton Ave, Mt Vernon, N. Y.

"It should look a little muddy, stupid. It's my coffee."



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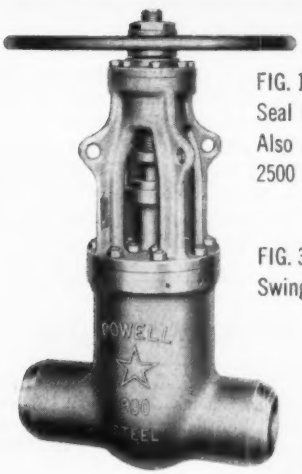


FIG. 19003 W.E.—Steel Pressure Seal Gate Valve for 900 Pounds. Also available for 600, 1500 and 2500 Pounds.

FIG. 3061 W.E.—300-Pound Steel Swing Check Valve.

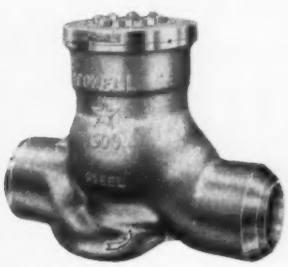
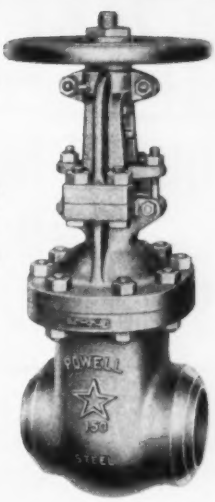


FIG. 1503 W.E.—150-Pound Steel O.S. & Y. Gate Valve.

FIG. 11365 W.E.—Steel Pressure Seal Horizontal Lift Valve for 1500 Pounds. 900-Pound Valves also available.



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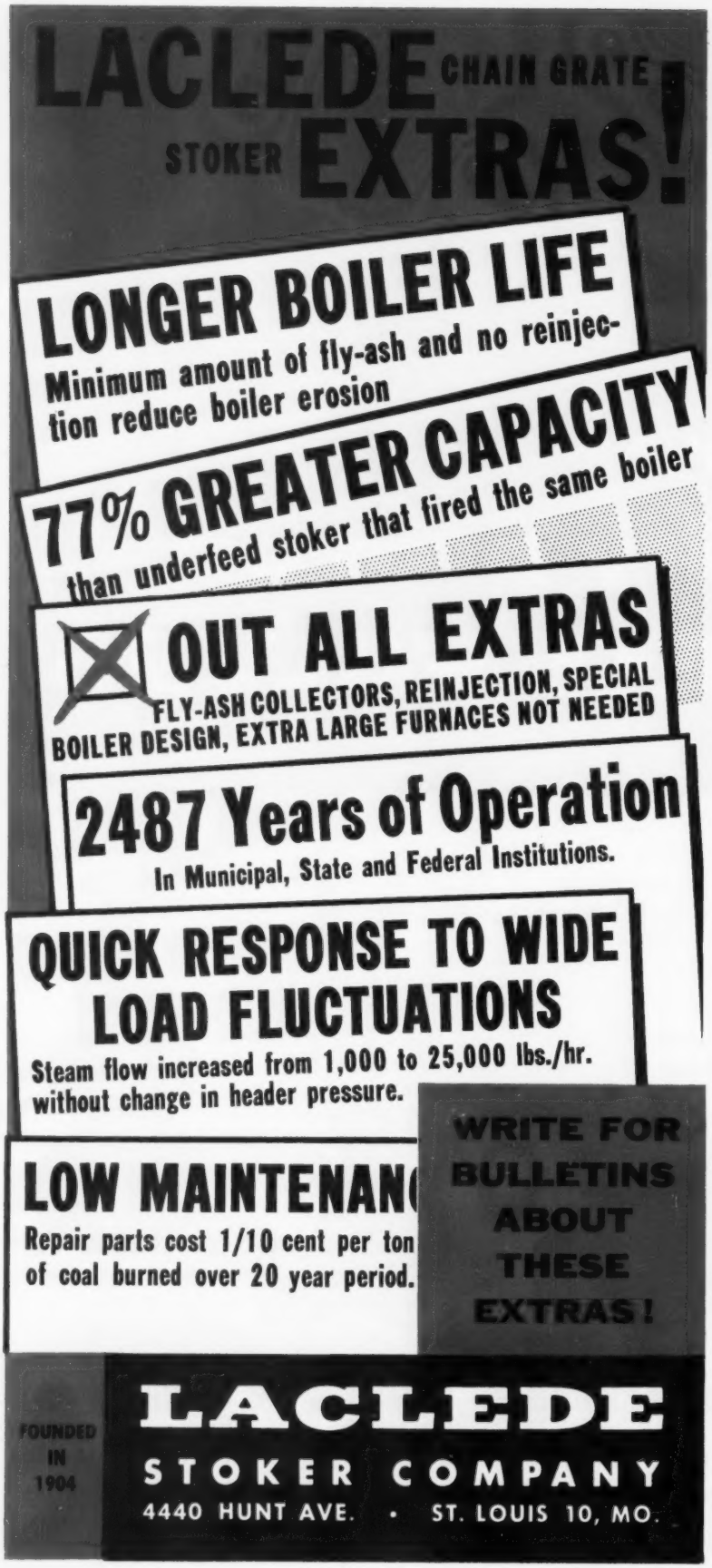
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LONGER BOILER LIFE
Minimum amount of fly-ash and no reinjection reduce boiler erosion
77% GREATER CAPACITY
than underfeed stoker that fired the same boiler
OUT ALL EXTRAS
FLY-ASH COLLECTORS, REINJECTION, SPECIAL BOILER DESIGN, EXTRA LARGE FURNACES NOT NEEDED
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In Municipal, State and Federal Institutions.
QUICK RESPONSE TO WIDE LOAD FLUCTUATIONS
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REPORTS from the FIELD

Begins on page 156

Engineers and Unions continued

old system has gone out the window. Many companies now employ hundreds of engineers, and personal contact has been lost.

This situation has left many engineers with the feeling that management regards them as hirelings.

In January, a survey of more than 800 engineers by *Electrical Engineering* revealed that 61% felt that they were not properly informed of company policy. As further evidence of discontent with management practice, 77% said they were given too much routine work. These men felt that their talents were being buried under a mass of clerical detail.

Despite the big demand for engineers today, 76% expressed dissatisfaction with their pay. The question seemingly is not one of a living wage. These men were using pay as a yardstick of prestige. Their pay, they felt, was not in line with their experience nor in proportion to that of unskilled labor.

Labor officials are using this pay question as one of their biggest guns. What labor did for the laborer, it can do for the engineer, they say.

The professional engineering societies see unionization as a threat to professional standing.

It is highly unlikely that any major decisions will be reached this year. The union themselves do not expect to make great inroads in this field for a long time to come. But they are bearing down and the resulting developments should prove interesting. POWER will keep its readers posted from time to time on the situation.

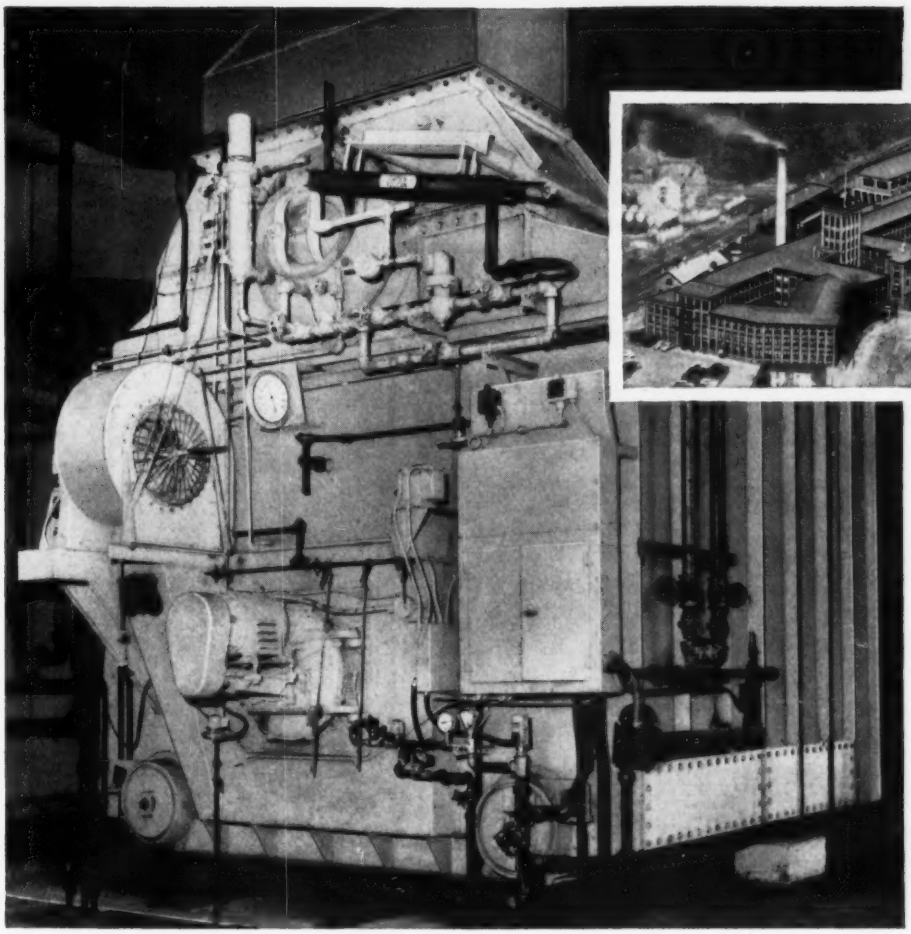
Calendar of Events

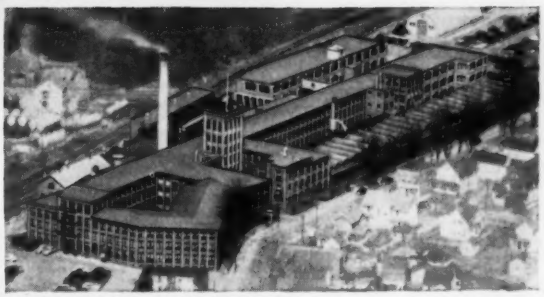
March 11-15—1957 Nuclear Congress, International Atomic Exposition. Convention Hall, Philadelphia. Details from exposition office, 304 Architect's Bldg, Philadelphia, Pa.

March 11-15—National Association of Corrosion Engineers, 13th Annual Conference and Exhibition. Kiel Auditorium, St. Louis, Mo. Details from NACE, 1061 M&M Bldg, Houston 2, Texas.

March 18-19—Steel Founder's Society of America, 55th Annual Meeting. Drake Hotel, Chicago, Ill. Details from SFSA, 606 Terminal Tower, Cleveland 13, Ohio.

March 18-21—American Society of Mechanical Engineers, Gas Turbine Power Conference. Sheraton Cadillac Hotel, Detroit, Mich. Details from ASME, 29





AERIAL VIEW OF TORRINGTON'S EXCELSIOR PLANT, TORRINGTON, CONN. Torrington is world renowned for its manufacture of bearings, needles, bicycles and metal specialties.

ONE OF TWO UNION TYPE MH PACKAGED BOILERS serving Torrington's Excelsior Plant. Equipped for oil firing, this unit has a steam capacity of 15,000 lbs./hr. at 250 psi.

Torrington racks up $12,500 savings in year with first of two Union Packaged Boilers

Selected because its "construction and design appeared better than others . . . physical size fitted into plans," a 20,000 lb./hr. Union Type MH Steam Generator was installed in the Excelsior Plant of The Torrington Company in October, 1955.

Providing steam for process and space heat, the new boiler quickly proved its worth. In October 1956, as a second MH Unit (15,000 lbs./hr.) was placed in operation, Torrington had this to say about the first: "Estimated savings for the first year are $12,500, as compared to our old coal burning hand fired boilers."

Throughout industry, numerous concerns report like economies as the result of modernizing with modern Union Type MH Steam Generators.

Completely shop-assembled at Union Iron Works for delivery via rail or truck, Union Packaged MH Units are patterned after larger but similar field erected Type H Boilers, originated by Union over 17 years ago.

With standard units designed in 13 sizes from 10,000 to 50,000 lbs. of steam per hour, Union Packaged Steam Generators can be readily equipped to handle multitudes of needs formerly requiring costly field erection and special engineering.

GET FULL DETAILS including cut-away illustrations, tube layouts and dimension tables by writing for Bulletin MH-353.

UNION

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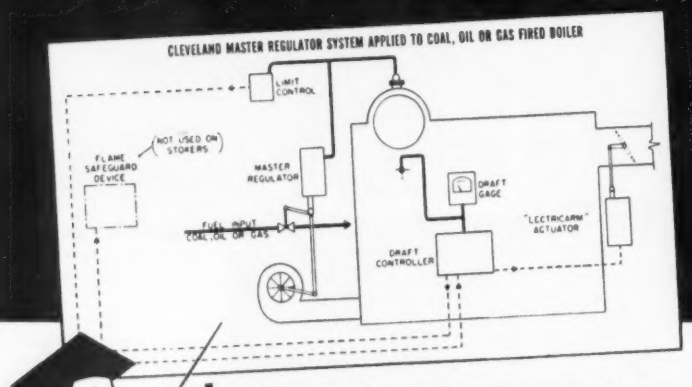
Free MANUAL ON COMBUSTION CONTROL SYSTEMS NO. 1 OF A SERIES



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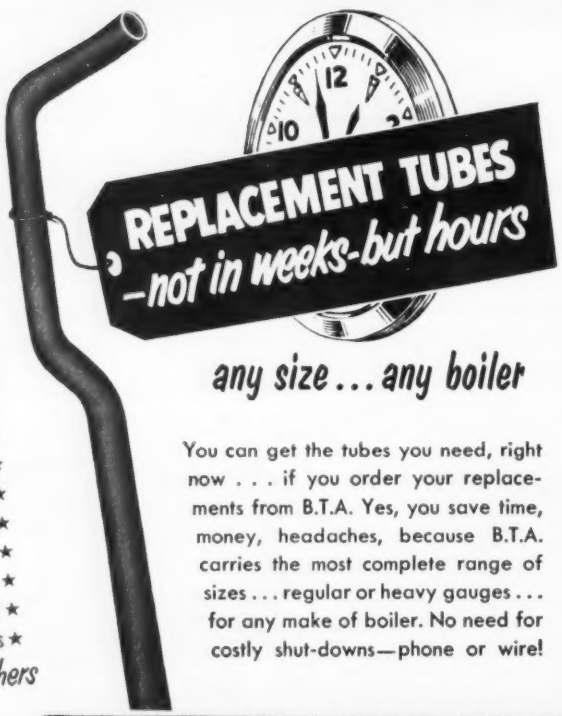
UNION IRON WORKS ★
VOGT ★
WICKS ★
and others



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any size . . . any boiler

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2B

REPORTS from the FIELD

Begins on page 156

W 39th St, New York 18, N. Y.

March 23-28—American Society of Tool Engineers, Silver Anniversary Technical Meeting and Convention. Shamrock Hilton Hotel, Houston, Texas. Details from ASTE, 10700 Puritan Ave, Detroit 38, Mich.

March 25-29—American Society for Metals, 10th Western Metal Congress and Exposition. Pan-Pacific Auditorium, Los Angeles, Calif. Details from ASM, 7303 Euclid Ave, Cleveland, Ohio.

March 27-28—American Society of Mechanical Engineers. Engineering Management Conference. William Penn Hotel, Pittsburgh, Pa. Details from ASME, 29 W 39th St, New York 18, N. Y.

March 27-29—19th annual American Power Conference, sponsored by Illinois Institute of Technology. Hotel Sherman, Chicago. Details from E R Whitehead, Secretary, American Power Conference, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill.

April 7-10—American Society of Mechanical Engineers, Instruments and Regulators Conference. Northwestern Univ, Chicago, Ill. Details from ASME, 29 W 39th St, New York 18, N. Y.

April 8-10—American Society of Mechanical Engineers, Spring Meeting. Dinkler-Tutwiler Hotel, Birmingham, Ala. Details from ASME, 29 W 39th St, New York 18, N. Y.

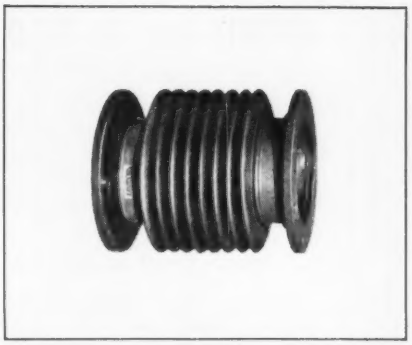
April 8-11—Rural Electrification Administration, 8th Annual Electric Generating Plant Operation and Maintenance Conference. Phillips Hotel, Kansas City, Mo. Details from Andrew S Reiff, N W Electric Power Cooperative, Inc, 312 N Chestnut St, Cameron, Mo.

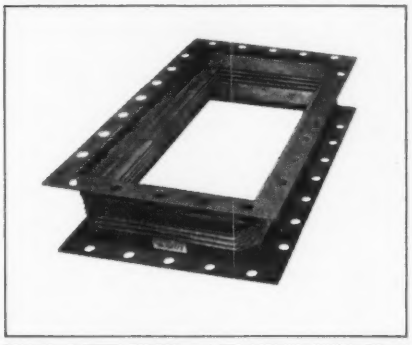
April 25-26—American Society of Mechanical Engineers, Management - SAM Conference. Statler Hotel, New York. Details from ASME, 29 W 39th St, New York 18, N. Y.

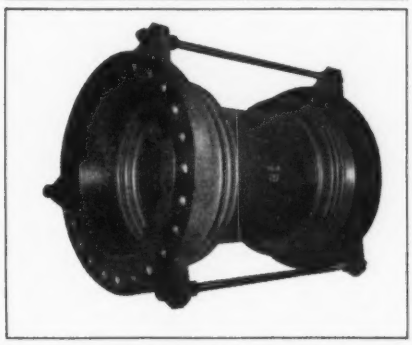
1957 American Power Conference kicks off this month

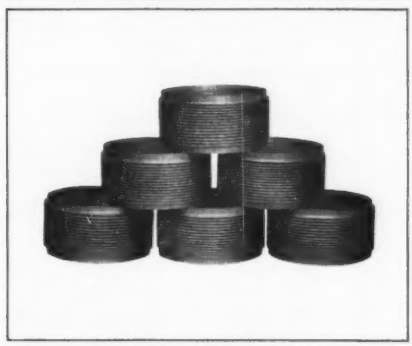
► THE AMERICAN POWER CONFERENCE, sponsored by Illinois Institute of Technology in cooperation with 13 universities and ten local and national engineering societies, will be held on March 27, 28 and 29, 1957, at the Sherman Hotel in Chicago. Purpose of the conference is to provide a forum for the exchange of information in the fields of power generation, transmission, distribution and utilization.

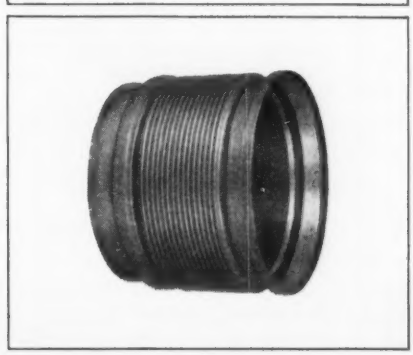
All interested persons are invited to attend. Registration and other in-











SOLA-FLEX®

EXPANSION JOINTS AND BELLOWS ARE MADE IN ALL SIZES AND VARIETIES

Write for Catalog

THE SOLA-FLEX LINE is the most comprehensive in the world. It includes many basic types of expansion joints—convoluted, U-span, rectangular, and others. Sizes range from ½ in. to 35 ft in diameter. Pressure ranges run from complete vacuum to standard 900 psi test and to higher pressures on special designs. Bellows have been built for service from—300 F to 2000 F. Materials used include all types of steels and a variety of high alloys.

Pipe expansion problems increase with higher pressures, temperatures and smaller space. Sola-Flex joints provide the answer—with economy and efficiency. Write for catalog today. Dept. C-139, Solar Aircraft Company, San Diego 12, California.

SOLAR

AIRCRAFT COMPANY

SAN DIEGO DES MOINES

DESIGNERS, DEVELOPERS AND MANUFACTURERS OF GAS TURBINES - AIRCRAFT AND MISSILE COMPONENTS - BELLOWS - CONTROLS - HIGH TEMPERATURE COATINGS - METAL ALLOY PRODUCTS.

PIPING LAYOUT IS SIMPLER with Gentile* FLOW TUBES

...THEY NEED SO LITTLE ROOM

Gentile Flow Tubes are impact type head meters for use as differential producers.

They are short and they need only minimum straight runs entering and following, and can be installed at practically any accessible point where flow conditions are reasonably steady.

Flow Tubes are furnished with individual head capacity curves, and for unusual piping arrangements, calibration curves for simulated conditions can be furnished.

Guaranteed

- Accuracy
- Minimum Head Loss
- Reproducibility

*GEN-TIL-LY

FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE UNION, N. J.

AUTOMATIC VALVES • CONTROL VALVES • SAFETY VALVES • FLOW TUBES

REPORTS from the FIELD

Begins on page 156

formation may be obtained from Dr E R Whitehead, Secretary, American Power Conference, Illinois Institute of Technology, Chicago 16, Illinois.

A partial listing of papers to be presented follows:

Wednesday, March 27, 1957

CENTRAL STATION STEAM GENERATORS: Economic effects of steam preheating combustion air on air heater and economizer surfaces; Incorporating heat from stack gases into the supercritical heat cycle at Eddystone Station; Operating experiences with twin furnace boilers; Advances in the field of large steam generators.

SYMPOSIUM ON EXTRA HIGH VOLTAGE SYSTEMS: Application of extra high voltage in France; The 275-kv system of the Central Electricity Authority in the United Kingdom; The Swedish 400-kv system; Consideration in the transition to extra high voltage transmission; The 345-kv systems of AG&E and OVEC.

WATER TECHNOLOGY I: An application of hot lime zeolite to moderate high pressure boiler operations; Operation of a large hot lime zeolite system for high pressure boilers; A survey of operating plants, problems, and successful operation.

Thursday, March 28, 1957

STEAM TURBINES: Economics of higher pressures and temperatures for steam turbines in industry; The Eddystone super pressure turbine; Advances in the field of large steam turbines.

WATER TECHNOLOGY II: The oxygen hydrazine reaction in boiler feedwater; Recent application results of the hydrazine - sodium sulfite combination; Three years' experience with hydrazine.

HYDROELECTRIC POWER DEVELOPMENT: Integration of hydroelectric and steam power on the Pacific Gas and Electric system; Economics of power generation for the TVA system.

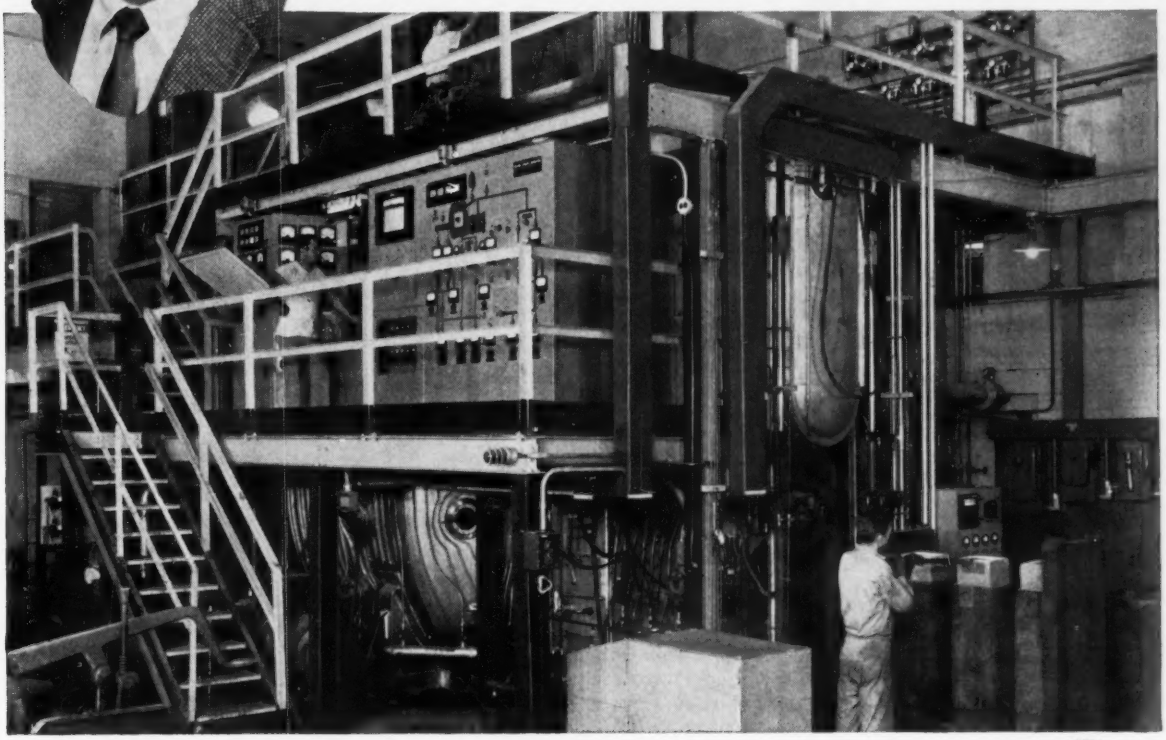
ELECTRICAL DISTRIBUTION: The Detroit Edison Company's standards for residential underground distribution; Distribution transformer loading by the load factor computer method; Distribution transformer loading from customers' kwh consumption.

CENTRAL STATIONS: Turbines, condensers and feedwater heaters and the laboratories that make them possible; Recent progress in the field of high pressure, high temperature power generation in Great Britain; Future of the steam cycle.

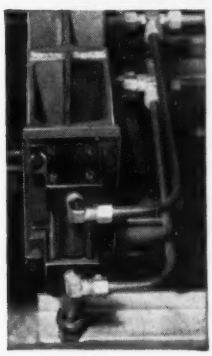
ELECTRIC SYSTEMS: Frequency and load control problems in a large power system; Operating experience with area

"Our experience demonstrated that hydraulic line rupture can occur in proximity to molten metal without fire when Cellulubes are used . . ."

Mr. Arthur E. Franks of Vacuum Metals Corporation, Syracuse, N.Y.



". . . this is why fire-resistant Celanese Cellulube hydraulic fluid is in use in the world's largest vacuum furnace at Vacuum Metals Corporation."



Hydraulic Controls on the world's largest vacuum furnace

In designing the hydraulic controls for its 2500-pound vacuum melting furnace, Vacuum Metals selected Cellulube hydraulic fluid because of its fire resistance and low vapor pressure characteristics. Laboratory tests and operating experience demonstrated that the unique combination of Cellulubes' properties made it the ideal material for this application.

These findings are typical of Cellulubes' performance during continuous operation under critical conditions. As hydraulic fluids, Cellulubes reduce the dangers of fires and explosions caused by line breaks or other equipment failures. As air cylinder lubricants, Cellulubes prevent the formation of excessive carbon deposits—the main source of compressor fires and explosions.

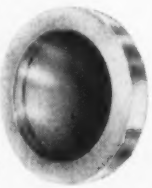
Available in 6 controlled viscosities, Cellulubes can be supplied to meet exacting requirements in the replacement of flammable fluids presently in use. Play it safe, write for complete data and technical assistance. Celanese Corporation of America, Chemical Division, Dept. **597-C**, 180 Madison Ave., N. Y. 16.

Celanese®
Cellulube®

Celanese
CHEMICALS

How to help prevent corrosion in a sight glass

PYREX® brand sight glasses stay clear longer because they resist the corroding and pitting effects of all chemicals except HF or strong, hot caustic solutions. No chance for an opaque build-up to prevent you from seeing the inside story when you use PYREX sight glasses.



You should use these glasses whenever you work with materials under heat and/or pressure. They withstand high temperatures and sudden changes of temperature, and will remain transparent through a long service life.

PYREX mold finished glasses are recommended for use when pressures are low or low pressures are accompanied by high temperatures.

PYREX annular edge glasses are designed for use on pressure vessels. They will safely withstand pressures up to 450 p.s.i. and temperatures up to 500 F.

There is a PYREX sight glass to fit your particular application. Let us send you a copy of Bulletin EB-20, which describes the properties, specifications and application of these glasses.

Corning means research in Glass

CORNING GLASS WORKS
CORNING, N. Y.

Please send me a copy of Corning Sight Glass Bulletin EB-20.

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REPORTS from the FIELD

Begins on page 156

control; Operating experience with dispatch computer in automatic power system control; The common sense of increment loading.

WATER TECHNOLOGY III: Report of joint research committee; Counterflow regeneration of deionizers; Anion exchange sub-fill as a factor in rinse requirements of demineralizers.

WATER TECHNOLOGY IV: Aluminous condenser tubes—Report on plant installation; Method of measurement and recording of small concentrations of oxygen dissolved in water.

Friday, March 29, 1957

GAS TURBINES: An operator's evaluation of the versatile gas turbine; The Mene Grande gas turbine plant; Design and characteristics of a combined gas and steam cycle for a 40,000-kw unit; Economics of small supercharged plants.

CONDENSER AND FEEDWATER CIRCUIT: Developments covering welding of non-ferrous tubes in steam-surface condensers; Fundamental need for welding non-ferrous tubes into feedwater heaters; Progress report on high speed boiler feedpumps; Boiler feedpumps for supercritical power plants.

NUCLEAR ENERGY: Inter-American progress toward economic nuclear power; Significant developments in large boiling water reactor plants; Plant design and operating problems of the Pennsylvania advance reactor; A new approach to the design of containment shells for atomic power plants.

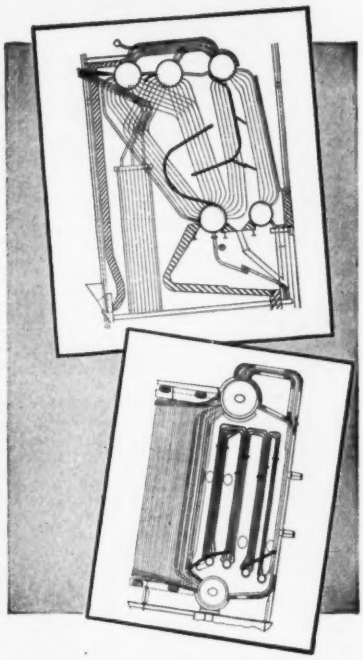
INDUSTRIAL POWER PLANTS: A new combined steam-gas turbine industrial power plant; Distribution of steam and electrical power costs in an industrial plant; Incremental efficiency testing of industrial turbine generators to determine steam rates and valve points; Economic dispatching of industrial turbine generators by valve points using a digital computer.

Japanese utility orders $5.5 million turbine-generator

► A 156,250-KW TURBINE-GENERATOR—largest type ever exported by Westinghouse—has been sold in Japan to the Kansai Electric Power Co, Inc, for installation in its new power plant at Osaka. The announcement was made by William E Knox, president of Westinghouse Electric International Co.

Valued at $5.5 million, the turbine-generator will be installed with a similar unit ordered for the Osaka station earlier this year. Together, the turbine generators will add two billion kw hours

ONLY ENCO BAFFLES *give you all these* COST CUTTING FEATURES



These important fuel-saving maintenance-reducing features are obtainable with Enco boiler baffles—*and only with Enco baffles.*

- **Streamlined gas flow**
- **Uniform gas flow**
- **Elimination of bottlenecks**
- **Reduced draft losses**
- **Higher heat transfer**
- **Cleaner heating surfaces**
- **Less use of soot blower**
- **Special provision for expansion**
- **Easy tube replacement**
- **Adaptable to any water-tube boiler, fired by any fuel**

Each application is designed on the basis of more than a quarter century of experience in this specialized branch of power engineering. Installations are made by skilled mechanics.

THE ENGINEER CO.
75 WEST STREET, NEW YORK 6, N.Y.
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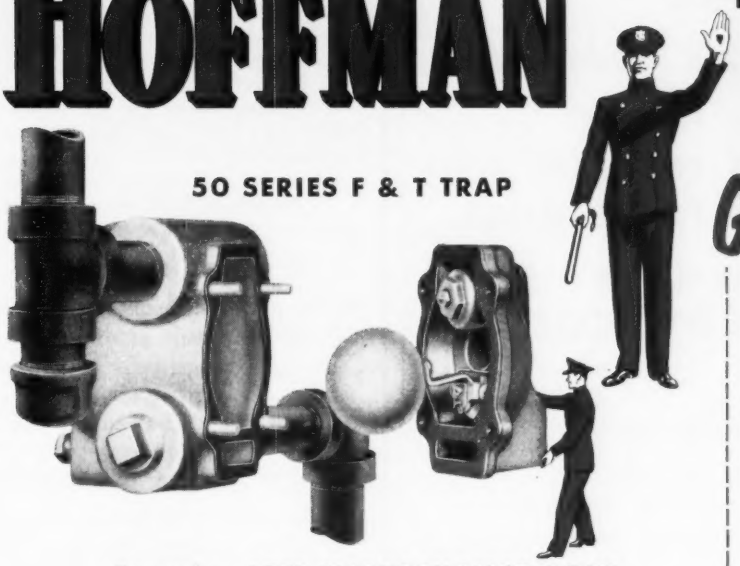
HOFFMAN TRAPS



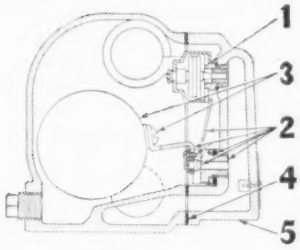
50 SERIES F & T TRAP

GUARD AGAINST STEAM WASTE

Hoffman Traps provide improved design to *function more effectively and economically in removing condensate* from steam lines and equipment.

Hoffman engineers have anticipated steam requirements that demand less maintenance time and operating costs. Typical of Hoffman's complete line are the Traps illustrated, each with removable cover, pin and seat for quick inspection and cleaning.

***Featuring* LOW MAINTENANCE COST**



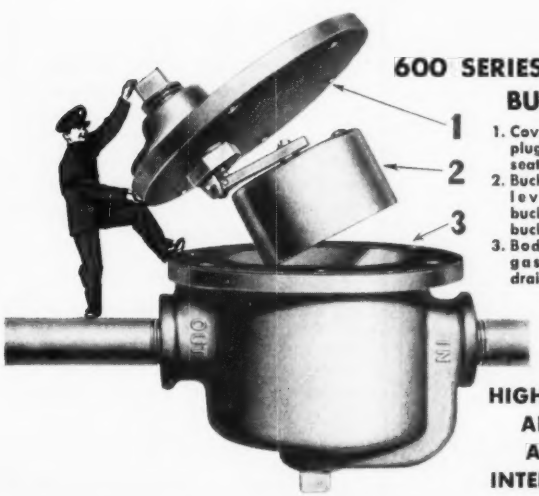
Float and Thermostatic Traps are so designed that all working parts of the trap are a part of the removable cover. Once installed there is no necessity for the breaking of any pipe connection for cleaning and repairing.

1. Compact Thermostat Assembly
2. Durable, accurately machined Valve Lever and Seat Assembly
3. Copper Float Ball Assembly
4. Graphite Impregnated Asbestos Gasket
5. Heavy Duty Cast Iron Cover

LOW, MEDIUM & HIGH PRESSURE THERMOSTATIC TRAPS

RENEWABLE THERMOSTATS and VALVE SEATS

A complete line of Low, Medium and High Pressure Thermostatic Traps for service with radiation, dryers, sterilizers, mangles, cookers and similar uses. Renewable thermostats and seats are important constructional features contributing to long life, low cost service. Medium and High Pressure Traps have stainless steel pins and renewable seats.



600 SERIES INVERTED BUCKET TRAP

1. Cover assembly with plug, valve seat, valve seat holder.
2. Bucket assembly with lever, valve stem, bucket pin, lock nut and bucket.
3. Body assembly with gasket and bottom drain plug.

HIGHLY EFFICIENT AND EASILY ACCESSIBLE INTERIOR DESIGN

Hoffman Bucket Traps operate intermittently and are ideal for draining condensate and air from steam lines or equipment where large quantities of air and condensate must be discharged. They are easily inspected, cleaned and serviced by merely removing the cover assembly.

For full particulars, write for catalogs on Bucket Traps, Float and Thermostatic Traps or Thermostatic Traps

HOFFMAN SPECIALTY MANUFACTURING CORP.

Measure Speed This Modern Way

FRAHM®
RESONANT REED
TACHOMETERS

SAFE • SIMPLE • SURE
LOW COST

JUST TOUCH

FRAHM® RESONANT REED TACHOMETERS require no contact with moving parts—no risk of accident—just touch it to the machine or motor housing.

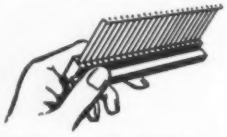
EASY TO READ

No calculations or conversions—just read the scale where the predominantly vibrating reed indicates, directly in rpm.

NO BUTTONS

No need for gear or range changing devices—read in any position—cannot be damaged by overspeeding. Available in ranges from 900 to 100,000 rpm.

NO MAINTENANCE



Nothing to go wrong, unless abused—no moving or wearing parts—hence no oiling or adjustment needed.

B-700

Want the full story?

Just ask for this interesting bulletin

JAMES G. BIDDLE CO.

Electrical Testing and Speed Measuring Instruments

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REPORTS from the FIELD

Begins on page 156

annually to the power supply of Southern Honshu. Kansai Electric, which services about 15% of Japan's population, provides power for the heavily industralized centers of Osaka, Kyoto and Kobe, plus six other major cities.

Westinghouse is building the turbines at its Sunnyvale, Calif plant and the generators at East Pittsburgh, Pa. Delivery of first unit is set for 1958.

Italian power company to buy 134,000-kw atomic plant

► AN OFFICIAL OF ITALY'S largest power company, Edisonvolta SpA, has announced that his organization plans to buy a 134,000-kw atomic power plant from Westinghouse Electric International Co.

According to Mr G Valerio, managing director of Edisonvolta, that company wishes to purchase "a duplicate of the pressurized water reactor being built for the Yankee Atomic Electric Co at Rowe, Mass." Edisonvolta hopes to have their plant in operation soon after the Yankee Atomic plant is in operation in the U.S.

Edisonvolta feels that atomic power is the answer to Italy's dilemma. As matters stand now, Italy's potential hydro-electric developments are limited. All conventional fuels are imported; are transported; and can be difficult to obtain.

Signing of the final contract will follow after problems connected with the sale are resolved. These include: 'an agreement of cooperation' between the U.S. and Italian governments, appropriate authorizations from the government agencies concerned, provision for supply of nuclear fuel for the life of the reactor, appropriate financial arrangements and insurance.

According to an announcement by David B Sloan, president of Gibbs & Hill Inc, New York consulting engineers, that company has established a permanent engineering office in the Wallace S Building, Tampa, Florida. E W Southworth has been appointed resident manager.

Successful use of high frequency electric current in fluorescent lighting was reported at the Winter General Meeting of the American Institute of Electrical Engineers in the Hotel Statler, New York.

Formation of the Union Carbide Research Institute to engage in basic scientific research has been announced by Morse G Dial, President of Union Carbide and Carbon. It will be built on Corp's Westchester property near Tarrytown, N. Y.

How Aitkin Light Plant came to choose STANODIESEL Oil M

Case story of exceptional results obtained with Standard Oil diesel lubricants

Because of plant operating conditions and generator capacity installed, Aitkin, Minnesota, Municipal Light and Power Plant had to operate a 1,235 H.P. Worthington engine over 38,000 hours before it could be taken out of service for complete overhaul. During that time, 19.2 million K.W.H. were generated. STANDARD HD Oil, predecessor to STANODIESEL Oil M was the lubricant.

When the engine was overhauled, all pistons were in good condition. All rings were free to move in ring grooves. There were no scars on cylinder liners. Piston walls were bright, wear was even. Based on this performance from STANDARD HD, plant management converted to the improved new oil—STANODIESEL Oil M—at the time of overhaul. STANODIESEL Oil M has been giving top performance ever since.

STANODIESEL Oil M is made from highest quality base stock. Additives help the oil resist viscosity change and keep parts clean. Other additives control foam, keep highly stressed parts lubricated.

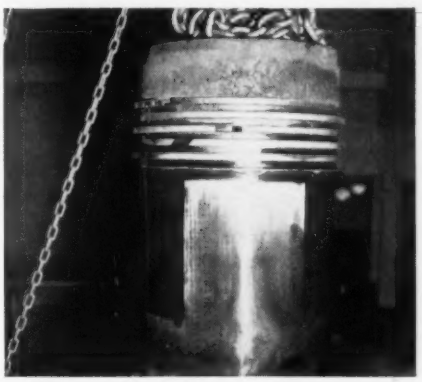
Get more information about STANODIESEL Oil M from your Standard Oil industrial lubrication specialist. There is one near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY
(Indiana)

STANDARD

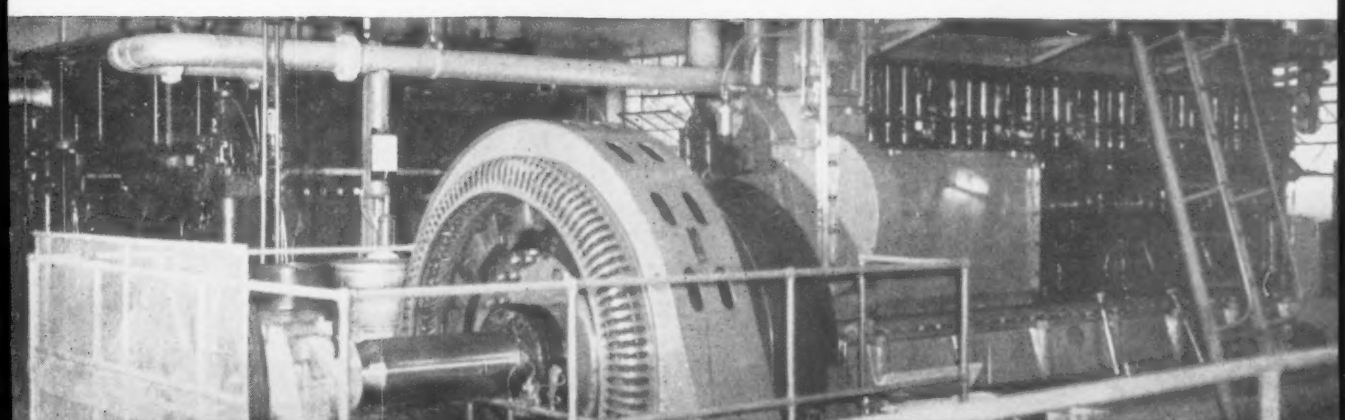
John Acklestad, Aitkin plant superintendent, and Carl Klenner (left) Standard Oil industrial lubrication specialist check engine service record. Carl has been rendering technical service on lubrication problems at Standard Oil for eight years. He has a degree from the Michigan College of Mining and Technology and has completed the Standard Oil Sales Engineering School.

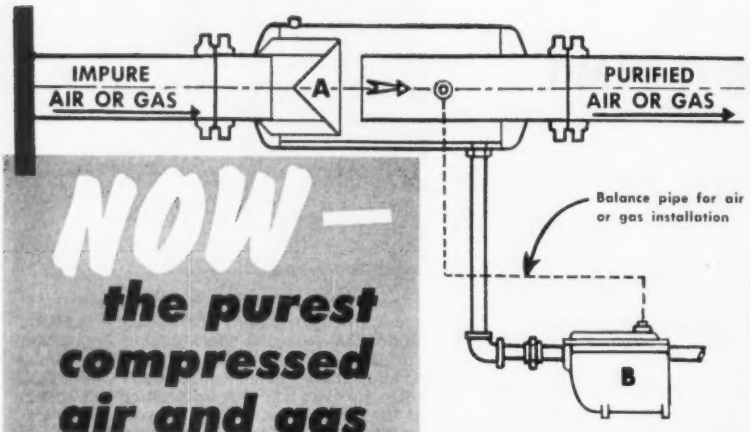
"As is" photo of piston removed from engine after 38,000 hours of service. Rings were free.



Quick facts about
STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by use of economy fuels.
- Maintains film on difficult to lubricate areas and parts.
- Eliminates spark plug fouling in spark ignited gas engines and reduces combustion chamber ash and deposits in engines burning natural gas, LPG and liquid fuels.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil commingle.



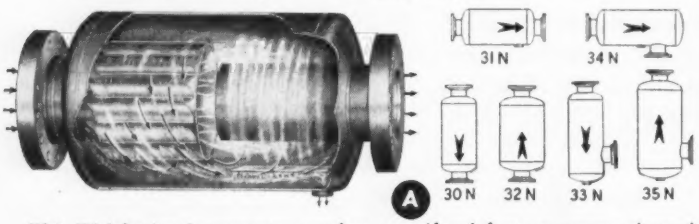


NOW— the purest compressed air and gas is yours with this W-A equipment

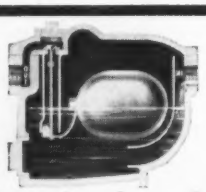
GUARANTEED TO REMOVE 99% OR MORE OF ENTRAINED MOISTURE AND SOLIDS

Where pipe lines carry compressed air and gas, liquids and solids are generally entrained in the gas stream. Wright-Austin 30N Series Separators can be used to remove foreign matter on a wide range of applications. For operating pressures to 5000 PSIG. Line sizes to 24". Here are some typical applications:

REMOVE
- —oil and water from compressed air supply lines
- —oil and water on compressed air service at outlet of inter-cooler and after-cooler equipment.
- —oil, moisture and tar between stages in coke oven gas compressors
- —oil and water from CO_2 gas lines
- —oil and water from hydro-carbon lines
- —entrainment from vapor lines following evaporation



This Wright-Austin separator employs centrifugal force to remove impurities from steam, air or gas flow. The pressure drop is extremely low. Type 31N, as well as other models shown, is light weight, compact and sturdily constructed according to ASME code.



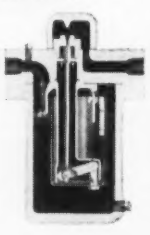
23-AC TRAP (0-125 PSIG)

Separated condensate flows to trap. Drainage is automatic. Particularly adapted where cold, gummy, emulsified cylinder lubricants make ordinary traps inoperative.

B

101-AC TRAP (0-600 PSIG)

Cast steel body, cover and bonnet. Designed for draining condensate where high pressures are involved. Internal mechanism all attached to cover for easy service.



WRIGHT-AUSTIN COMPANY
3245 WIGHT STREET • DETROIT 7, MICH.

WRITE FOR NEW CIRCULAR 506-A

REPORTS from the FIELD

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British nuclear power group developing small atomic plants

► SMALL, EASILY TRANSPORTABLE, nuclear power plants may soon be generating electricity in remote mining areas and serving as atomic work horses for scores of other industrial uses in the less developed countries.

The dream of the ultimate peaceful use of atomic energy is being translated into reality by one of Britain's largest industrial combines in a bid for leadership in the "new industrial revolution."

The Hawker-Sidderly Group, Ltd, has announced that its subsidiary, the Hawker-Sidderly Nuclear Power Company, has made notable progress in its development of advanced reactors for electrical generation.

Company officials indicated that work has begun on a liquid metal fuel type of reactor which, it is hoped, will make more efficient use of uranium. The United Kingdom Atomic Energy Authority has said that this is one of Britain's most advanced projects.

Industrial repair center opened in New Jersey

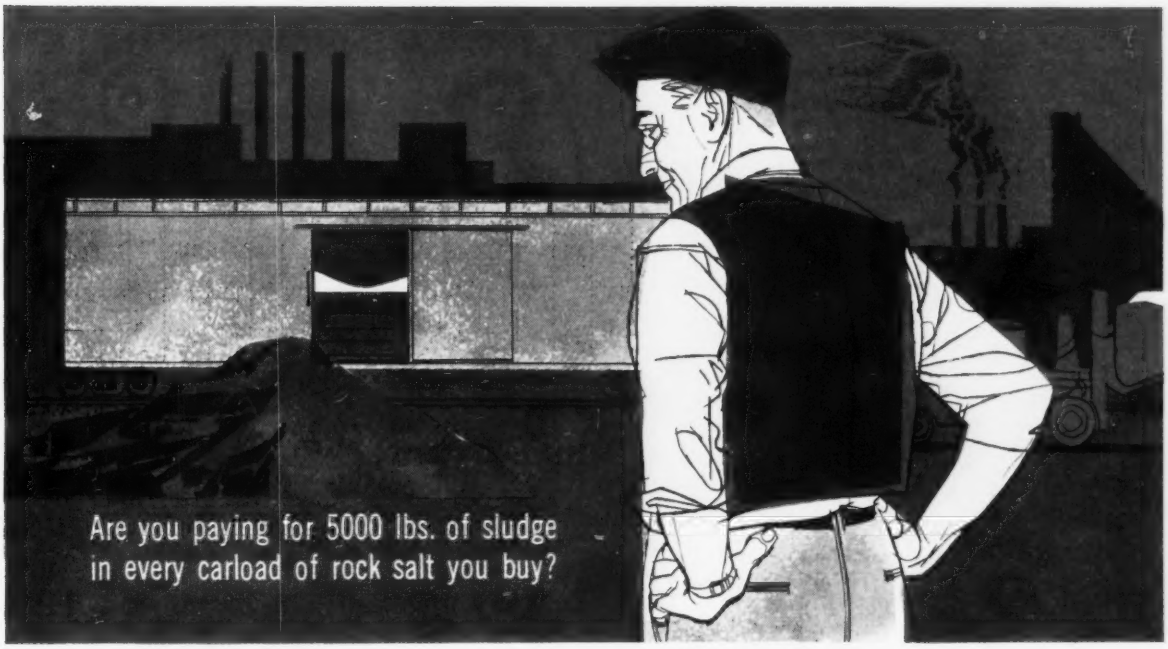
► ONE OF THE NATION'S largest industrial repair centers, equipped for emergency repair or overhaul of anything from a small motor to a locomotive or large turbine has been opened in North Bergen, N. J. to serve the greater New York area.

The new multi-million dollar structure, which combines vast warehouse facilities, is the latest in the General-Electric Co's chain of 53 service shops designed to serve customers of the firm's Apparatus Sales Division.

Harold Bongarten, manager of the new shop, said facilities will operate 24 hours a day, including Sundays and holidays, with maintenance specialists on call at all times. Shop is geared for repair of all marine, transportation and industrial-utility electrical equipment.

Located at 6001 Tonnelle Ave, the new semi-automated shop replaces facilities formerly located at 416 W 13th St, Manhattan. and 10th St in Long Island City.

A contract for the complete control system for a 1000-kw nuclear reactor to operate in South America has been awarded to Leeds & Northrup Co by the Babcock & Wilcox Co. The swimming pool type reactor is being constructed by Babcock & Wilcox for Sao Paulo University, near Sao Paulo, Brazil. It will be used by the university for nuclear research projects.



Switch to sludge-free Purex Salt

In every 100 lbs. of rock salt you buy you assume the risk of paying for up to 5 lbs. of insolubles or sludge—shale and sulphates. This means that in a 50-ton carload of rock salt you may pay for as much as 5,000 lbs. of sludge! This insoluble matter is included in the purchase price of the rock salt and accounts for part of your freight bill. It also necessitates periodic cleaning out of your brine making system.

But when you buy Morton Purex Salt, you get high-purity evaporated salt that is made in a controlled particle size to prevent packing and channeling. With Purex, none of your purchase price or freight bill goes toward paying for insolubles or sludge.

With Purex, no time or labor is wasted in cleaning out insoluble matter from your brine making system to keep it functioning at peak capacity. For Purex is 100% soluble. Morton Purex Salt will leave no accumulation of material in either the brine or water softener tanks. It can be used in bulk wet storage systems and in the Morton Model E Brinemaker.

These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.

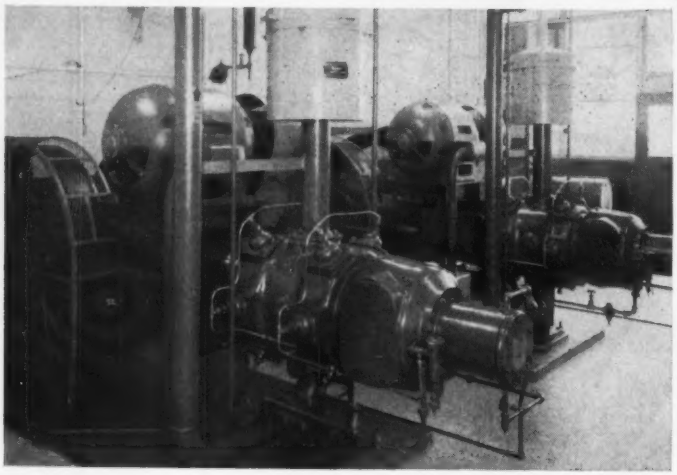
Southern Rock Salt | Northern Rock Salt

Kansas Rock Salt | Morton Purex Evaporated Salt

Tests for insolubles taken from these random samples show you that Morton Purex is the only one that contains no wasteful sludge, or insolubles.

For more information about Morton Purex Salt and for free, expert help on any water softening or brine making problem, write or wire:

MORTON SALT COMPANY
INDUSTRIAL DIVISION
Dept. P-3, 120 So. LaSalle Street,
Chicago 3, Illinois



Guaranteed
OIL-FREE AIR
with performance-proven
Pennsylvania
CLASS 3-ATC
"OILFREAIR" Compressors

PPC

Here are oil-free compressors *guaranteed* to compress air entirely free of oil or oily vapor due to lubricants!

And here's why PENNSYLVANIA OILFRE compressors with Tailrod Construction are so often the logical choice for oil-free compressed air:

SPECIAL LONG, DUST TIGHT DISTANCE PIECE assures that no part of the piston rod which enters the lubricated frame will alternately enter the air cylinder stuffing box.

FULL-FLOATING CAST IRON PISTON with carbon piston rings. Piston rod has both crosshead and tailrod bearing supports.

HONED CYLINDER BORE in addition to Full-Floating piston promotes long life for carbon piston rings.

CARBON PACKING in both cylinder stuffing boxes.

AIR CUSHION VALVES, designed without nuts, bolts or screws to burn fast or work loose are constructed with corrosion-resistant metals.

PENNSYLVANIA has furnished *guaranteed* oil-free compressors for more than twenty years. Here is an OILFREAIR compressor comparable in performance and maintenance to the standard lubricated compressor. WRITE TODAY FOR BULLETIN PE 202.

PENNSYLVANIA PUMP and COMPRESSOR COMPANY
Main Office & Works, Easton, Pennsylvania
HAE-PPC 358-157 ***Earning Confidence Since 1920***

PENNSYLVANIA
PUMP AND COMPRESSOR COMPANY

BOOKSHELF

International Dictionary of Physics and Electronics. *1004 pp, illust, $20.00. Van Nostrand, 120 Alexander St, Princeton, N. J.*

Here in one volume, to meet the demands of the atomic and electronic age, are definitions of all the principal terms used in classical and modern physics.

Prepared by a group of scientists and educators, dictionary has terms from 16 major subject divisions which are designed to provide the exact definitions needed in everyday work.

Terms defined here include laws, relationships, equations, basic principles and concepts, as well as the most widely used instruments, apparatus and their components. This treatment comprises the terms of pure science as well as those of its applications.

Nuclear Metallurgy. *54 pp, $3.75. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc, 29 W 39th St, New York 18, N. Y.*

The effects of irradiation of metals in atomic reactors is the subject matter of this book. Included are three articles by authors presenting technical papers at a Symposium on Nuclear Metallurgy conducted by the Institute of Metals Division of AIME during their annual Fall meeting held in October 1956. These are: *Theory and Mechanism of Radiation Effects on Metals,* by George H Vineyard, Brookhaven National Laboratory; *Irradiation Effects in Physical Metallurgical Processes,* by Donald E Thomas, Westinghouse Electric Corp; *Irradiation Effects in Reactor Materials,* by Donald S Billington, Oak Ridge National Laboratory.

Industrial Vision. *By Henry W Hoffstetter, Director, Optometry School, Indiana University. 187 pp, illust, $10.00. Chilton Publications, Chestnut and 56th Sts, Philadelphia 39, Pa.*

"About 75,000 disabling eye injuries occur each year . . . in the U.S.A. . . . some 72% occur on jobs regarded as non-hazardous to the eyes." These two little-known facts, taken from *Industrial Vision,* point up the need for increased knowledge and training on the part of all concerned with this problem.

Covering the whole field of industrial eye hazards and protection, Dr Hoffstetter includes the relation of vision, visual testing and visual skills to industrial performance, production and safety. Also given are industrial eye hazards and protective programs, methods of evaluation of efficiency for compensation purposes, and vision in relation to automobile and truck driving.

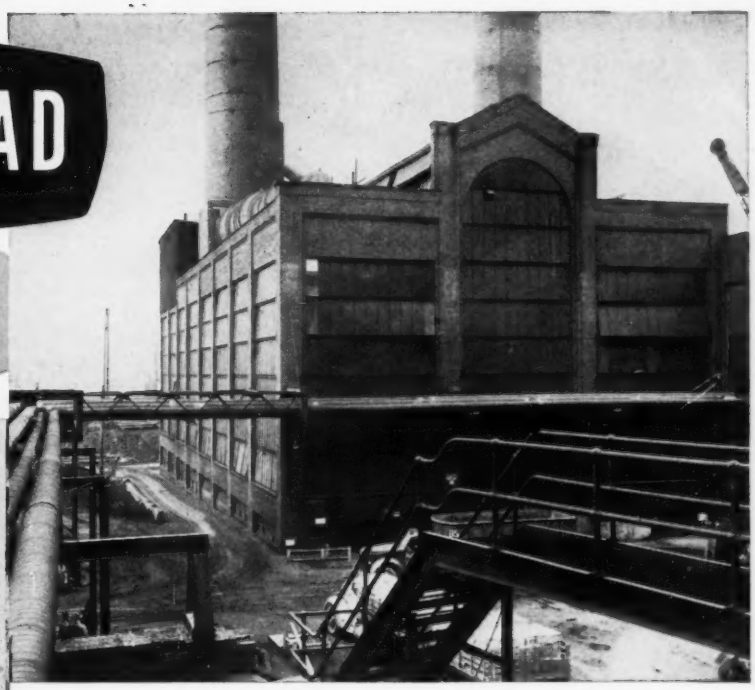
This is a text that will interest not only the student in eye care, but will prove valuable to the safety engineer, plant manager, personnel manager, motor vehicle inspector—all industry.

(*Continued on page* 240)

OVERHEAD

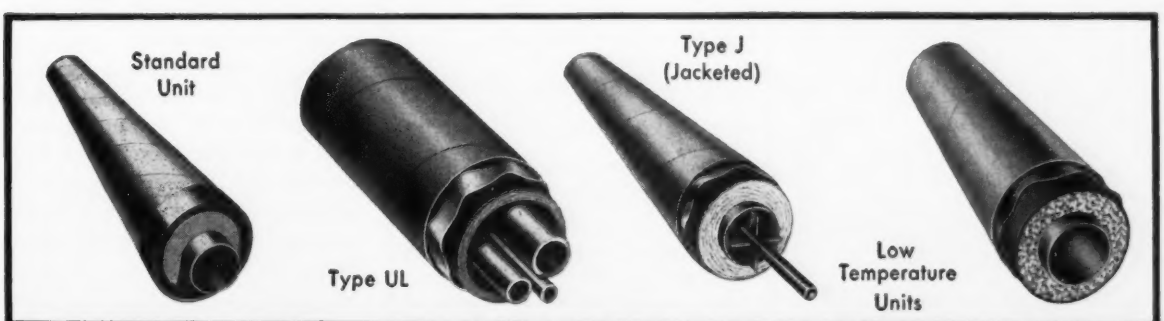
OR

underground



Ric-wiL offers the COMPLETE quality line of prefabricated piping systems

Ric-wiL factory prefabricated piping systems, *timed* to your schedule and *shipped* directly to the job site, can save you valuable time and money. Insulated units are available for steam, hot water, oil, other viscous fluids, process liquids and refrigeration lines . . . and remember . . . Ric-wiL is the quality system of exceptionally high mechanical strength and thermal efficiency.



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. . . of Exceptionally High Thermal Efficiency

RIC-WIL INCORPORATED — PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

Write for a copy of the new Ric-wiL Catalog . . .

FOR THE FULL TREAT-MENT,

WATER TREATMENT, THAT IS

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NEW YORK OFFICE: 141 E. 44TH ST., NEW YORK 17, N. Y.
CANADIAN DIST. PUMPS & SOFTENERS, LTD. LONDON, ONT.

More BOOKSHELF

Begins on page 238

Transport Processes in Applied Chemistry. *By R C L Bosworth, Senior Research Associate with Colonial Sugar Refining Co, England. 387 pp, $12.00. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

Giving a unified presentation, Dr Bosworth provides a common phenomenological description of the various transport processes—electric curent, flow of heat, mass and momentum, and certain scalar processes such as physical relaxation and chemical reaction—in terms of driving force, flux, resistance and rate of energy dissipation.

The author also reintroduces the concept of a carrier and discusses the kinetic mechanisms of all types of transport processes on the basis of types of carrier responsible for the flow. Also clearly explained are the phenomena arising when the same carriers operate for different flow processes, or when the flow of one class of carrier gives rise to the flow of another.

Brown's Directory of American Gas Companies, *1956-57 edition. 515 pp, $35.00. Moore Publishing Co, Inc. 48 W 38th St, New York 18, N. Y.*

Sixty-ninth annual edition of this gas industry reference book brings up-to-date data and information concerned with production, transmission and distribution of natural and manufactured gas in the U.S. and Canada.

In all, the new edition contains over 38,000 revisions, including latest names, titles and addresses of more than 8000 gas company executives, engineers and department heads; latest data on miles and sizes of mains for all gas companies; up-to-date information on communities served, number of meters, types of customers, kinds of gas used, and rate schedules for all gas companies; new information on home service directors and representatives; and expanded listings and data on gas transmission companies.

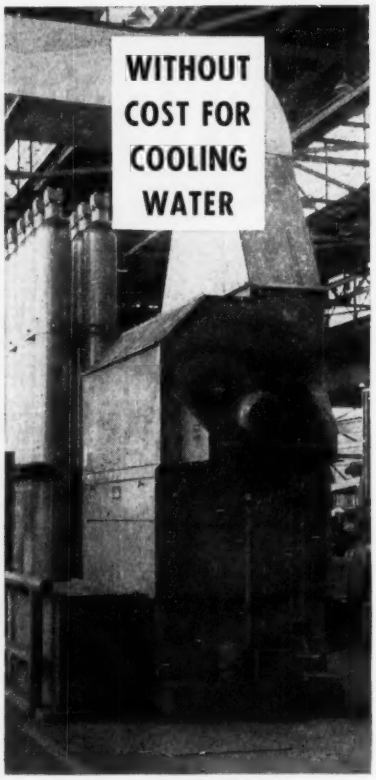
"Accident Facts," 1956 edition, *is now available from the National Safety Council. This 96-page booklet contains facts and figures on all types of accidents—industrial, traffic, home, farm and school.*

Twenty pages are devoted exclusively to occupational accidents. The book is an invaluable source of data for speeches, reports and safety work. Price $1 per copy. Contact National Safety Council, 425 N Michigan Ave, Chicago 11, Illinois.

Glossary of Electric Terms—Financial and Technical. *By EEI Statistical Committee. 50¢. Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.*

Glossary was compiled to serve as a guide for laymen and utility personnel in preparation and general interpretation of electric utility industry statistics.

Practical definitions are given for over 300 terms and, in addition, many others



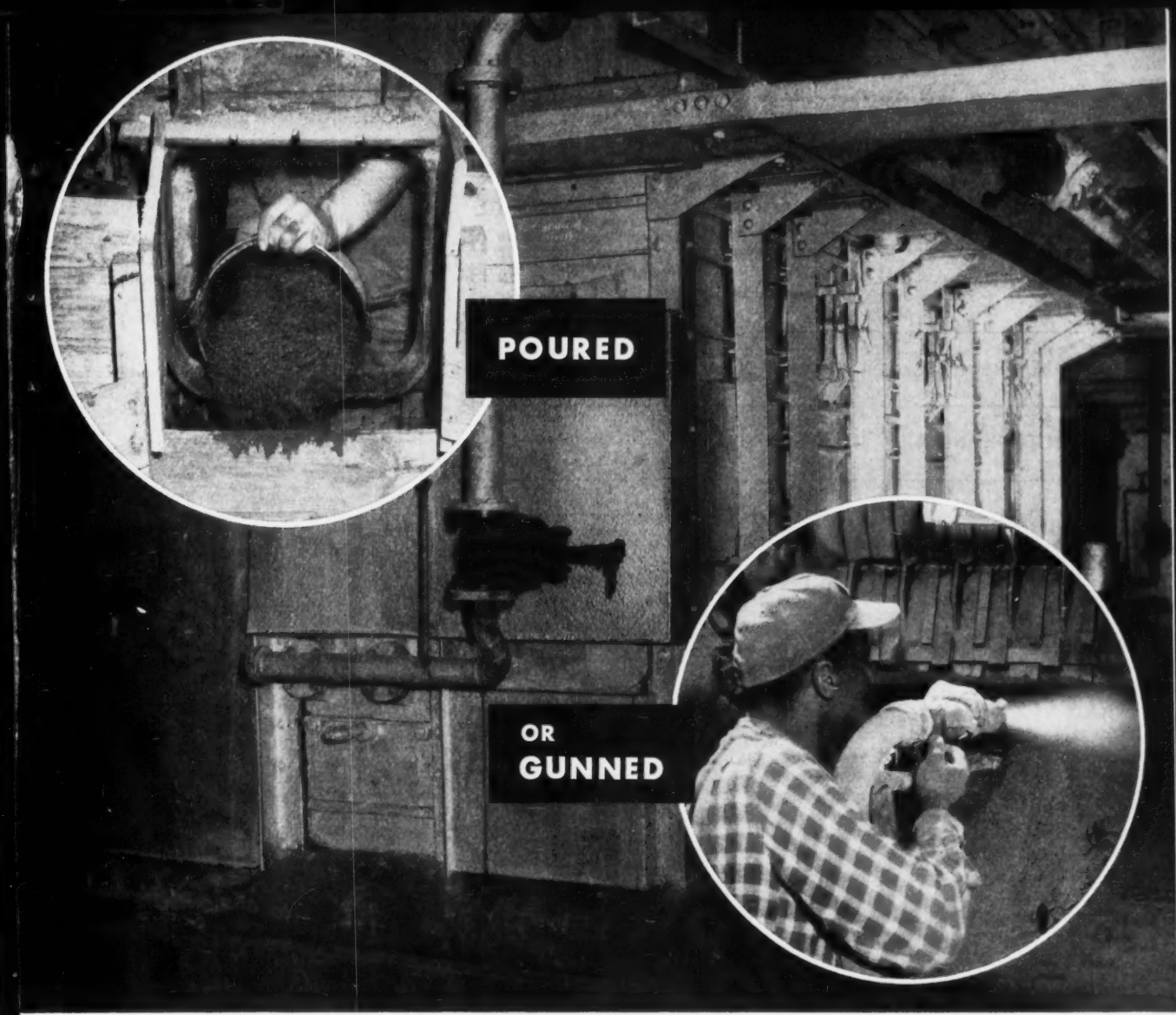
ACCURATE TEMPERATURE CONTROL of Hydraulic Liquids PREVENTS LOSSES

• This NIAGARA AERO HEAT EXCHANGER cools the liquid for a large hydraulic press, preventing heat damage to the pump stuffing boxes. Using outdoor air as the evaporative cooling medium, it removes the heat at the rate of input (1,875,000 BTU/hr.) with no cooling water consumption except a negligible amount evaporated.

Similar Niagara machines cool water, oils, solutions, lubricants and coolants for many mechanical, electrical and chemical processes. In a closed system, your coolant is never contaminated. The system is simple and easy to keep up; the equipment has a long, useful life.

Write for Bulletin 120
for a complete description

NIAGARA BLOWER COMPANY
Dept. P, 405 Lexington Ave.
NEW YORK 17, N. Y.
District Engineers in Principal Cities of United States and Canada



B&W Kaocrete Refractory Castables withstand punishing ashpit service

Continuous or intermittent sprays, high velocity water jets for ash removal, rakes and shovels — all these are responsible for the heavy abrasive and erosive attack on ashpit linings. But you can cut the frequency of maintenance and expensive relining jobs by using heavy-duty refractory castables which can be poured or gunned in place.

Specially designed for ashpit service, B&W Kaocrete D has the strength and hardness needed to stand up under these severe conditions. It has unusually high resistance to abrasion, erosion and spalling. Widely used in all types of boiler ashpit hoppers and slag tanks, Kaocrete D has proved its economy and durability. Where abrasive and erosive conditions are less severe, B&W Kaocrete A will give satisfactory service.

Your local B&W Refractories Engineer will be glad to give you complete details on the performance of these B&W Refractory Castables.

Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

R549

CORROSION

TYPE	HOW TO IDENTIFY
GALVANIC	Localized deep grooves or pits, often at contact between dissimilar metals.
UNIFORM	Uniform attack—may be on only one part.
INTERGRANULAR	Attack at grain boundaries.
PITTING	Rapid, deep pitting at several small areas. May be uniform or highly localized.

Why you can conquer all four kinds of corrosion with Goulds chemical pumps

When you buy Goulds Fig. 3715 chemical pumps you can build *specific* protection against all four types of corrosion.

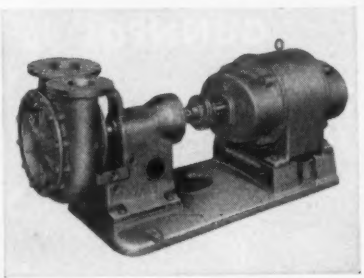
Match the pump metal to your liquids. You can have the *entire* fluid end of the pump made of 316 stainless, Gould-A-Loy 20, nickel aluminum bronze, iron, iron with stainless trim or nickel aluminum bronze trim. These metals from stock. Any machinable alloy on application.

All machined parts in all metals held to same close clearances permitting economical alloy changes in the field . . . the entire liquid end or any component as conditions warrant.

Choosing from this wide range of metals, you can combat the different corrosive actions of hot acids, alkalies, slurries, sizes, or whatever other corrosive liquids you pump.

Match pump size to job

You can get Goulds Fig. 3715 in 9 sizes: capacities to 720 GPM, heads to 200 ft. Other features of Fig. 3715: water-jacketed support head permits handling liquids at 350°F.; impeller clearance can be adjusted without dismantling the pump. For more information, write for Bulletin 720.4.



These larger pumps also fight corrosion

For larger capacities or heads, you can get these other Goulds pumps in metals that resist specific corrosion:

Fig. 3405—single stage, double suction; 19 sizes; capacity to 6400 GPM, head to 425 ft. Bulletin 721.6. Popular sizes available in 316 stainless steel from stock.

Fig. 3305—two stage, opposed impellers; 8 sizes; capacity to 1200 GPM, head to 1000 ft. Bulletin 722.6.

Fig. 3189—single stage, open impeller; 11 sizes; capacity to 1080 GPM, head to 180 ft. Bulletin 720.4.

Goulds PUMPS INC. Seneca Falls New York

Branches: Atlanta • Boston Chicago • Houston New York • Philadelphia Pittsburgh • Tulsa

West Coast Representative: Goulds Pumps Western, Portland, Ore.

In Canada: The A. R. Williams Machinery Co., Ltd. in all principal cities.

More BOOKSHELF

Begins on page 238

are indexed and defined by cross-reference. Definitions are not intended to spell out exactly the purpose, nature or content of accounts, and are not binding on member companies of the Institute. Neither are they recommended for legalistic interpretations. They are regarded, however, as generally descriptive of predominant and objective practice.

Selected ASTM Engineering Materials Standards. *Heavy paper cover, 6x9, 370 pp, $4.00, $1.50 to students of recognized engineering colleges. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

This compilation has been prepared for use by college engineering students and teaching staffs. By supplying representative illustrations of nationally accepted standard specifications and standard test methods that support them, the student can be made familiar with the existence, availability, nature and origin of the specifications for the materials which all engineers must use.

Specific standards were selected on the basis of a poll among engineering educators. They are intended to include not only the standards most closely linked to the work of the course but also standards that illustrate the varied nature and approach to problems of standardization.

Electrical Testing and Troubleshooting. *By Philip T Green, Industrial Training Coordinator, Panama Canal Zone Co. 200 pp, illust, $4.00. The Industrial Press, 93 Worth St, New York 13, N. Y.*

This book presents, in convenient step-by-step form, procedures for electrical testing and troubleshooting that have been used in the field by men responsible for installation and maintenance of electrical equipment. It covers a variety of methods of testing and correcting faults in circuits of all kinds including controllers, motors, transformers and transmission lines. The book will serve as a useful guide for practicing electricians and a basic text for those in training.

City Public Service Board, San Antonio, Texas has awarded a contract to Gibbs & Hill, Inc, New York consulting engineers, for design of a 100,000 kw extension to its Leon Creek steam-electric generating station. When extension, named Unit No. 4, is completed in 1959, it will increase Leon Creek station's output to 232,000 kw.

One of the two largest steam turbine power plants ever to be exported by Westinghouse, a 156,250-kw high-efficiency unit costing about $11,500,000, has been sold to Kyushu Electric Power Co, Inc, of Japan.

One of the biggest piston-engine electrical power plants in Canada is being developed by British Columbia Power Commission at Prince George, B.C.

Your boiler is very likely big enough to take advantage of famous Ljungstrom efficiency. Even boilers as small as 25,000 pounds of steam per hour have grown up to a Ljungstrom. Completely shop-assembled, this new unit arrives in one package, ready for installation. And you can expect these immediate results:

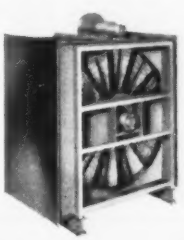
FUEL SAVINGS: Generally, ten percent or more. This alone means write-off is possible in approximately three years.

INCREASED BOILER OUTPUT: Preheated air makes higher combustion temperatures, which means higher steam producing capacity.

LESS MAINTENANCE: Better combustion reduces slag, makes for longer periods between overhaul. Cleaner stack gases. Less smoke nuisance.

EFFICIENT USE OF EVEN LOWER GRADE FUELS: Higher furnace temperatures allow effective burning of low grades.

Find out how the efficient, low-cost Package Ljungstrom Air Preheater can be applied to your steam-generating units. Write today to the Air Preheater Corporation. Free brochure on request.



This "package preheater" is for boilers in the 25,000 to 200,000 pound per hour range

The Package Ljungstrom operates on the continuous regenerative counter-flow principle. The heat-transfer surfaces on the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming air.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

if

you have any of these troubles:

1. **SCALE, CORROSION, or FOAMING** *in your boiler operation.*
2. **RUST and CORROSION** *in your steam and condensate lines.*
3. * **SCALE, CORROSION, or ALGAE GROWTH** *in your cooling or condenser water system.*
4. **CORROSION or SCALE** *in your hot or cold water tank and lines.*
5. **RUST and CORROSION** *in your brine or sweet water system.*
6. **SCALE** *in pumps, water jackets, compressors, coils, lines, or equipment.*
7. **SLUDGE and MOISTURE** *in your fuel oil supply.*
8. **SOOT DEPOSITS** *in your furnace combustion areas.*

then . . . let WESTERN prove to you how a specific treatment applied to your specific problem can restore and maintain efficiency and economy in your use of water, steam and fuel. Check the number or numbers of the problems you have in the coupon below. Get full information.

*** for example**

. . . Western's Cooling Water Treatment has been technically formulated and proved in use to prevent scale deposits, corrosion and algae growth in cooling towers, engine jackets, condensers, coils and piping.

Over 65 Years of Know-How In the Chemical Treatment of Water

Chemical Treatment for Water Steam and Fuel

WESTERN CHEMICAL COMPANY

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Kansas City 5, Missouri

MAIL THIS COUPON TODAY

Send information on the problems checked:

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5 ☐ 6 ☐ 7 ☐ 8 ☐

Other_____

Name_____

Firm_____

Address_____

City_____ Zone_____ State_____

APPOINTMENTS

Corporation executive changes

The J G White Engineering Corporation: Dudley F Phelps, president; Stephen P Darlington, vice-president, engineering; G H O'Sullivan, vice-president, new business. **Warner Electric Brake & Clutch Company:** Alonzo A Neese, chairman of the board. **Arcos Corporation:** Royal D Thomas, chairman of the board; R David Thomas Jr, president; James E Norcross, executive vice-president; Henry A Molt, vice-president, manufacturing.

Buell Engineering Company, Inc: Robert F Playter, chairman of the board; J A McBride, president and general manager; John H Nicholls, vice-president and secretary; Henry Dohrman, vice-president, engineering; S J Pascual, vice-president, sales. **Crane Packing Co:** Carl E Schmitz, executive vice-president; Vance E Voorhees, vice-president, sales; B H Stenberg, vice-president, manufacturing. **Air Reduction Company, Inc:** George E Hawkins, executive vice-president. **Hammond Iron Works Company:** Ralph E Kramer, executive vice-president, general operations and sales.

Borg-Warner Corp: Henry M Haase, president and chief executive officer of York division. **The International Nickel Company of Canada:** J Roy Gordon, executive vice-president. **Union Carbide Nuclear Company:** Adolph Q Lundquist, vice-president. **The Babcock & Wilcox Company:** S T Mackenzie, vice-president, sales, boiler division. **H K Porter Company, Inc:** Emmett H Mann, vice-president and general manager, Leschen Wire Rope division.

Engineer changes

Socony Mobil Oil Company, Inc: Robert Q Sharpe, chief engineer of lubricating department. **Borg-Warner Corp:** J F Weiffenbach, director of research and engineering. **Texas Gas Transmission Corp:** James N White, ass't superintendent of design engineering; Gerald A Suddoth, supervisor of compressor station construction; James O King, senior staff engineer. **The Babcock & Wilcox Company:** Paul M Brister, manager of engineering design section, manufacturing engineering department. **Federal Pacific Electric Co:** Donald C Mills, manager of development engineering for Eastern switchgear division.

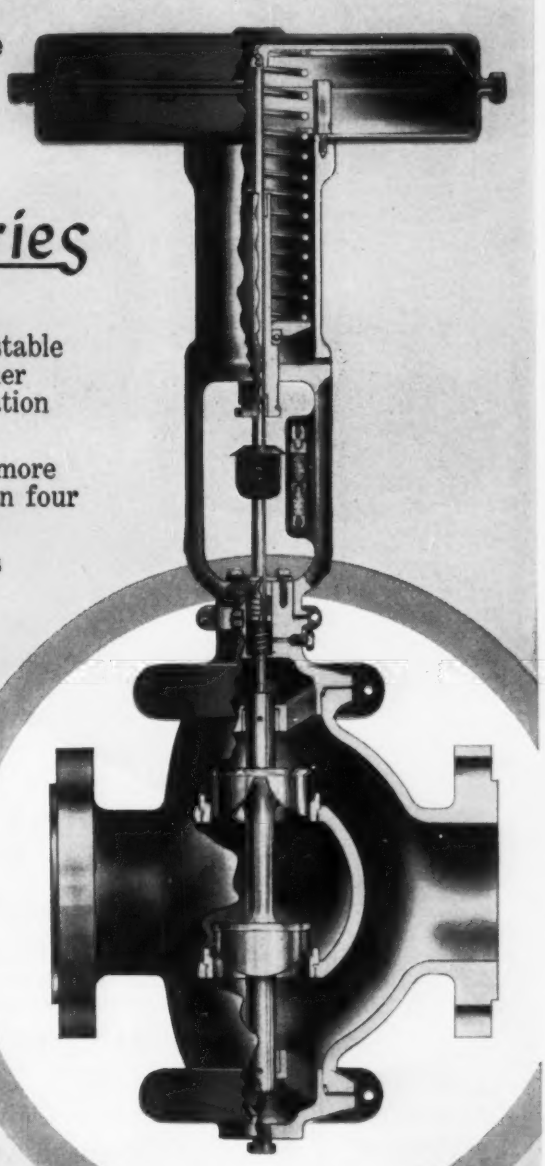
Sales changes

Conoflow Corporation: J Robert Simpson III, sales manager. **Elliott Company:** Howard A Bach, sales manager of Lagonda division. **Sterling Engine Company:** E J van Dyk, sales

TAKE A GOOD LOOK...

...At The Redesigned Valve Body Of The New BS&B

Super 70 *series*



NEW Streamlined flow contours provide more stable flow at all rated differentials and any inner valve position. Turbulence and cavitation are minimized.

NEW Accurately engineered inner valves give more exacting flow characteristics. Available in four types, top and bottom guided.

NEW Patented all-metal float ring seal provides positive self-actuating closure... tightens with the application of pressure.

NEW Forged clamp ring allows yoke orientation to any position. Requires only two bolts... eliminates annoyance of gasket replacements.

Super "70" Series valve bodies are available in three styles... single port, double port and split body for use in erosive or corrosive fluid service where easy removability of valve seat is desirable. All bodies can be reversed without change of parts or special tools. Split and bolted stem connector is strong, easily accessible and quickly assembled. Bolted stuffing box assembly with stainless steel follower includes spring-compressed Teflon as standard packing. Steel bodied valve dimensions are in accordance with ASA Standards B 16.5—1953.

EFFICIENCY · OVER 60 YEARS · RELIABILITY
BS&B
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

This advertisement highlights features of the Super "70" Series Valve Bodies only. Another will detail features of the Super "70" Series Topworks. Watch for it!

BLACK, SIVALLS & BRYSON, INC.
Controls Division, Dept. 4-Q3
7500 East 12th Street
Kansas City 26, Missouri

DROP FORGED
for Strength

HOT FORMED
for Weldability

Hot formed steel is not subject to weld cracking, a chronic complaint on cold rolled products.

HEAT TREATED
All Thredolet fittings are heat treated after forging in accordance with A.S.T.M. A105.

ANTI-CORROSIVE LACQUER COATING
All Bonney fittings stay new and ready-to-use years after leaving our factory. Threads do not get clogged with grit as do oil-preserved fittings.

BONNEY

WELDOLETS ®
THREDOLETS ®
SOCKOLETS ®
BRAZOLETS ®
ELBOLETS ®

CARBON STEEL
STAINLESS
ALLOY
for all services

consider these features then specify and use BONNEY Thredolets and Sockolets for all small branch connections . . . and Weldolets for all large branch connections.

PENNSYLVANIA DIVISION
BONNEY FORGE & TOOL WORKS
DEPT. L ALLENTOWN, PENNSYLVANIA

More APPOINTMENTS

Begins on page 244

manager. **Superior Foundry, Inc:** Warren W Brown, manager of sales and marketing. **Raybestos - Manhattan, Inc,** Manhattan Rubber and Packing division: R F Teeling, Eastern regional manager, with following district managers—Stewart Monroe, New York, J T M Frey, New Jersey and F McBrearity, Philadelphia; A L Hawk, Central regional manager with following district managers—A N Johnston Jr, Pittsburgh, G S Himebaugh, Chicago and E T Fair, Denver; C P Shook Jr, Southern regional manager with following district managers—A A Ringland, Birmingham, A E Jackson, New Orleans, E W Nagel, Dallas and R C Nielson, Houston; S V V Hoffman, Western regional manager with R B Park, San Francisco district manager.

The Carpenter Steel Company: Robert Potter, New England sales manager for alloy tube division. **Rockwell Manufacturing Company:** Orville Cochran, Denver district sales manager, meter and valve division. **S K F Industries, Inc:** James H Sutherland, director of sales; Edward H Wagner, Midwestern regional sales manager. **Tuthill Pump Company:** John W See regional sales manager, New England, New York, New Jersey and eastern Pennsylvania.

New representatives

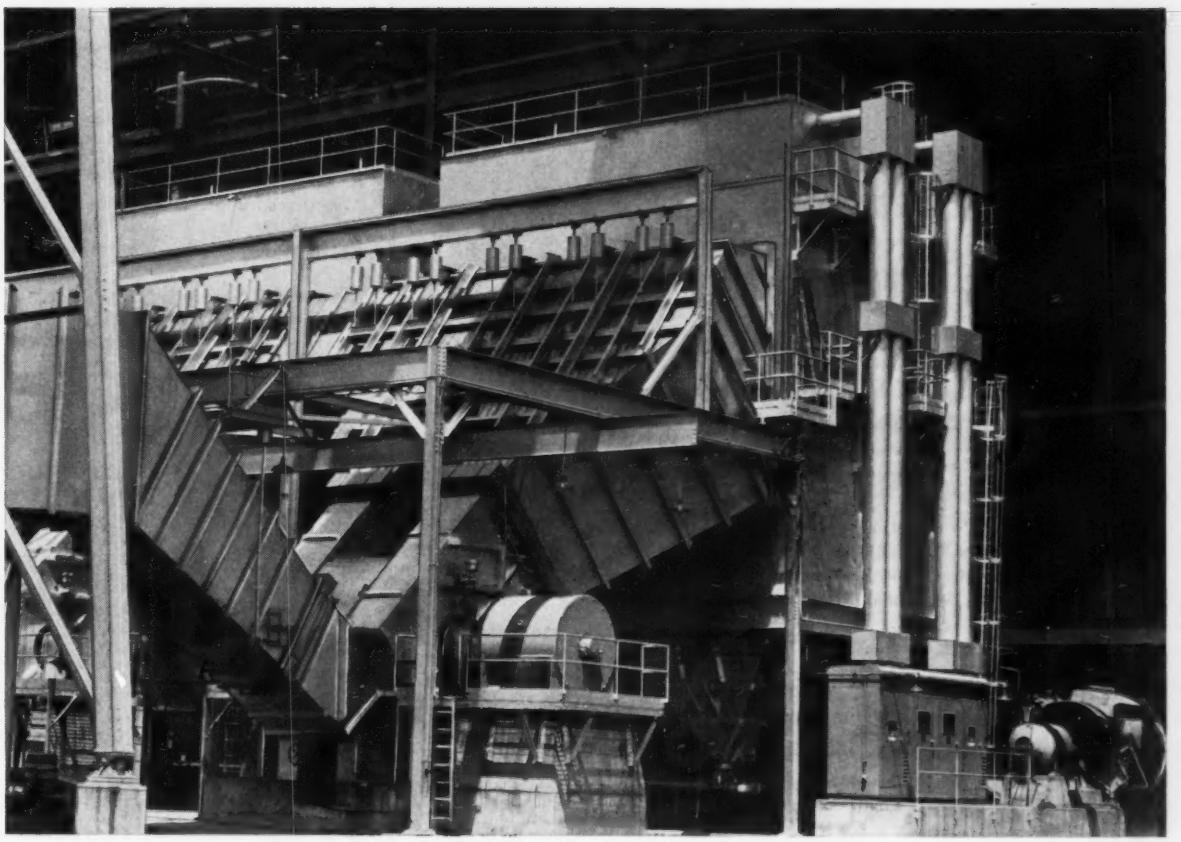
For **Cleaver-Brooks Company:** J U Kaye and Company, 940 Western Ave, Pittsburgh 33, Pa. For **Servo Corporation of America:** Russell F Clark Company, Pittsburgh, Pa. For **Water Service Laboratories, Inc:** Aaron Misrock, 728 E Main St, Richmond, Va. For **The Hewson Company, Inc:** Thomas H Closs, 21 W Pennsylvania Ave, Towson 4, Md.; Dittman & Greer, Inc, 33 Pleasant St, Middletown, Conn.; Honolulu Electrical Products Co, Ltd, 930 Clayton St, Honolulu, Hawaii. For **Sorensen & Company, Inc:** Pinkney & Hine, 1925 Nicollet Ave, Minneapolis 3, Minn. For **Fisher Governor Company:** Clarence B Petty & Co, 50 Kearney Rd, Needham Heights 94, Mass.

Recent purchases, mergers

Robertshaw-Fulton Controls Company: acquisition of The Beta Corporation, Richmond, Va., and acquisition of Acro Manufacturing Company, Columbus, Ohio. **Kaiser Aluminum & Chemical Corp:** purchase of wire and cable business of United States Rubber Co. **Hubbard and Company:** purchase of Illinois Gear & Machine Company, Chicago.

Recent moves

Automatic Switch Co: to new plant and offices at Florham Park, N. J. **The**



For this Midwest power station, Westinghouse induced draft (center) and forced draft (right) fans move a total of 92,500,000 cubic feet of air and gas every hour, every day.

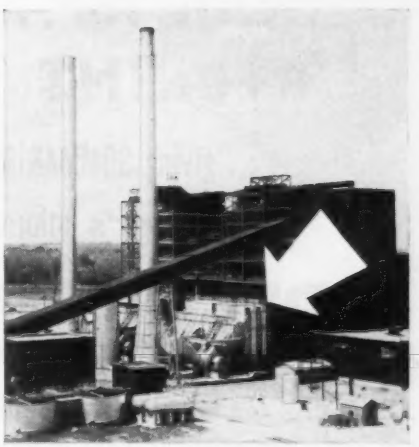
8 All-Weather Westinghouse Fans Supply Mechanical Draft to Meramec Station of Union Electric

Air-cooled bearings, welded steel construction resist elements

Eight Westinghouse Turbovane mechanical draft fans with vane control supply draft to the two boilers of the Meramec Station of Union Electric Company located in St. Louis, Mo. Installed outdoors where they are exposed to the varying elements, these fans perform their part of a vital power-generating job with only routine maintenance.

Four of these fans are Turbovane forced-draft type arranged double width, double inlet. The other four are Turbovane induced-draft fans with radial-tipped blades and erosion-resistant wheels. Vane control on all fans allows instantaneous regulation of air volumes to meet changing steam demands.

For power generation—or for any other air handling job—check on Westinghouse-Sturtevant apparatus today. Let the industry's most complete air handling line *put air to work* for you—efficiently, economically. Call the Westinghouse-Sturtevant specialists located in your area or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

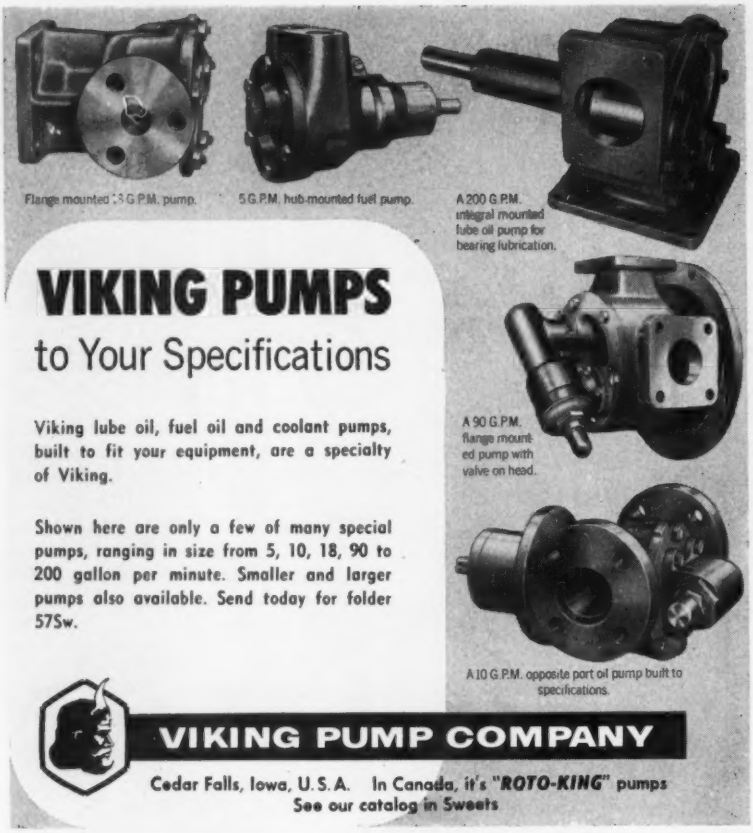


Located at the heart of power generation at Meramec, four Westinghouse forced draft fans supply 150,000 cfm each, at 11.3 inches water gauge while operating at 1180 rpm. These are teamed with four Westinghouse induced draft fans handling 235,500 cfm each, at 277°F and 17.1 inches water gauge while operating at 700 rpm.

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S Westinghouse

J-80417


Flange mounted 3 G.P.M. pump.
5 G.P.M. hub-mounted fuel pump.
A 200 G.P.M. integral mounted lube oil pump for bearing lubrication.
A 90 G.P.M. flange mounted pump with valve on head.
A 10 G.P.M. opposite port oil pump built to specifications.

VIKING PUMPS

to Your Specifications

Viking lube oil, fuel oil and coolant pumps, built to fit your equipment, are a specialty of Viking.

Shown here are only a few of many special pumps, ranging in size from 5, 10, 18, 90 to 200 gallon per minute. Smaller and larger pumps also available. Send today for folder 57Sw.

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "*ROTO-KING*" pumps
See our catalog in Sweets

Write for....Power's REPRINT FOLDER

. . . giving SUMMARIES and PRICES on

Power's information-packed

SPECIAL REPORTS

"the most useful condensed handbooks in the power and plant service field."

POWER, 330 West 42nd Street
New York 36, N. Y.

Gentlemen: Please send me a copy of Power's "Reprint Folder".

Name.....

Address.....

City & State.....

More APPOINTMENTS

Begins on page 244

Scam Instrument Corporation: to new quarters at 1811 W Irving Park Rd, Chicago 13, Ill. **Johnson Service Company:** Salt Lake City, Utah branch office to 1193 S 3rd West St; Phoenix, Arizona branch to 2641 E Adams St.

Retirements

Chauncey N Mynderse, vice-president and director of Robertshaw-Fulton Controls Company, after 40 years of service.
Donald I Bohn, manager of special electrical development engineering, Aluminum Company of America, after more than 34 years of service.
Wayne Belden, president of the Ajax Flexible Coupling Co Inc. He will continue on the board of directors as marketing and public-relations counsel.

Obituaries

Howard W Memmott, industrial sales manager of The Connecticut Light and Power Company, on December 22nd.
Henry V Erben, 58, an officer of the General Electric Company and one of the nation's foremost leaders in the electrical industry, on December 26th.
S W Andrews, 66, a director of The Fluor Corporation, Ltd and president of H G Acres and Company Ltd, a Fluor affiliate, on December 31st.
E W Baird Jr, 59, president of T J Cope, Inc, on January 15th.

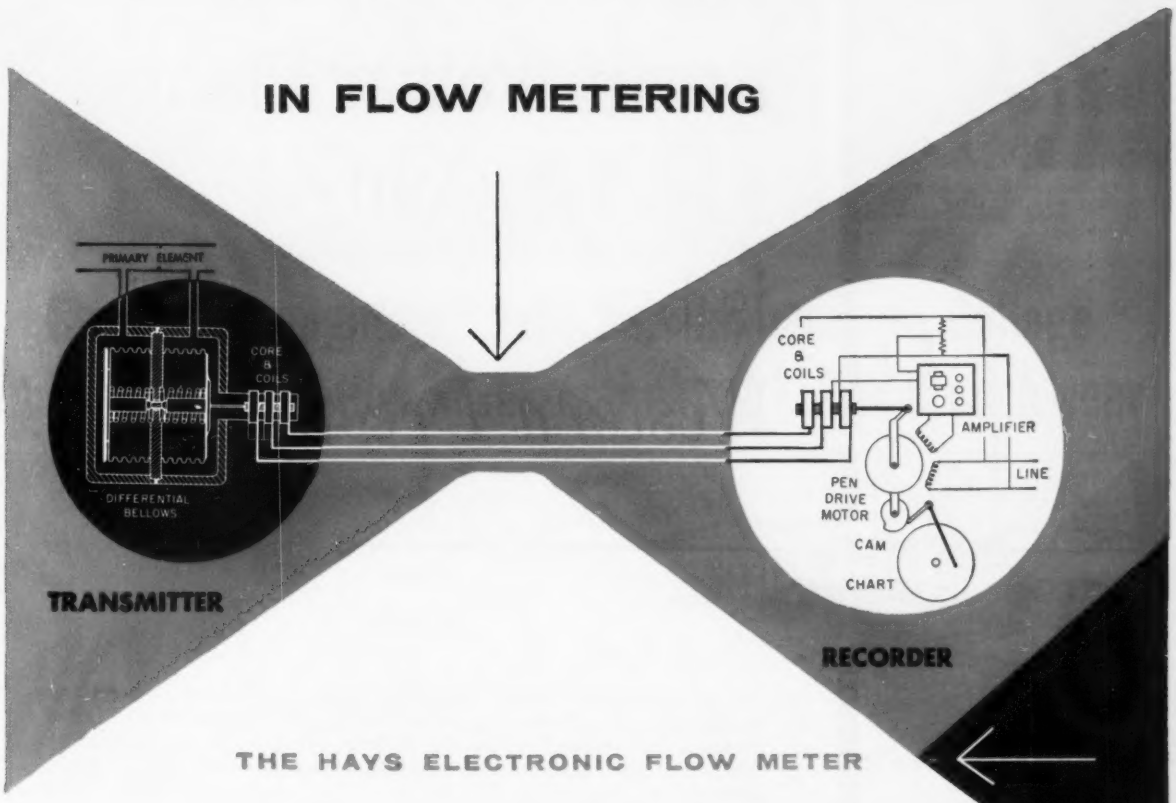
The Electric Storage Battery Co has been awarded a contract in excess of $3 million for submarine batteries for the U.S. Navy.

Horizons Inc, Cleveland, Ohio, has been awarded a $200,000 development contract by the Navy Bureau of Aeronautics. Contract covers the development of a commercial method for producing virgin titanium metal by an improved Horizons' electrolytic process.

"Cheeking for vacuum leaks?"

new dimensions

IN FLOW METERING



THE HAYS ELECTRONIC FLOW METER

THE **hays** CORPORATION

MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Veriflow Meters and Veritrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

Here is a new Flow Meter—that is really new! These features of the Hays Electronic Flow Meter speak for themselves.

Mercuryless—costly mercury maintenance headaches eliminated—no mercury to lose.

Rupture-proof Bellows—provide positive protection against over-range.

Continuous integration—motor-driven continuous mechanical integrator is extremely accurate even on rapid load changes.

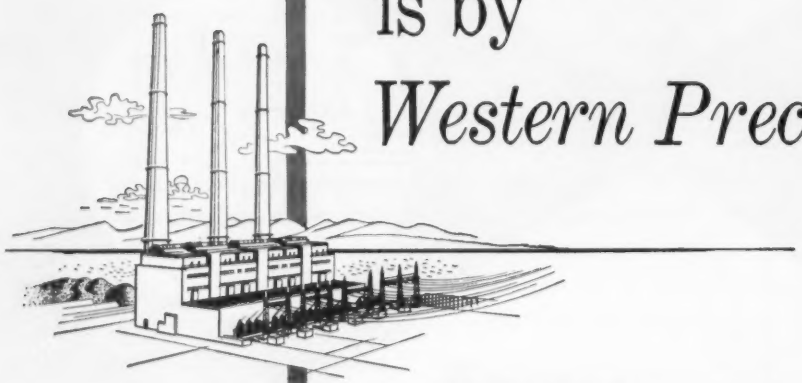
Electronic operation—requires only 4 seconds for full scale pen travel with accuracy of ¼% of full scale differential.

Other features include null-balance transmission, powerful motor, easy readability, accuracy unaffected by normal temperature changes. Explosion proof transmitters and wide range meters also available.

For complete information, write for Bulletin 56-1074-222.

A Record Unmatched In The Industry . . .

In *Every One* of the Nation's "Top Six"* Steam Power Plants, Fly Ash Control is by *Western Precipitation!*



As most power plant executives know, the Federal Power Commission annually "rates" the major steam power plants of the United States to determine their overall thermal efficiency as represented by their heat rate (i.e., BTU of fuel consumed per KWH of generated power).

*The "Top Six" steam plants according to the most recent Federal Power Report are . . . 1. Kyger Creek Plant (Ohio Valley Electric) . . . 2. Clifty Creek Plant (Indiana-Kentucky Electric) . . . 3. Kanawha River Plant (Appalachian Electric Power) . . . 4. St. Clair Plant (Detroit Edison) . . . 5. Muskingum River Plant (Ohio Power) . . . and 6. Tanners Creek Plant (Indiana and Michigan Electric).

We at Western Precipitation Corporation, take great pride in the fact that—in EVERY ONE of these "Top Six" plants—the equipment selected for fly ash control is WESTERN PRECIPITATION equipment.

Could there be any greater testimony to the outstanding superiority and unsurpassed efficiency of Western Precipitation fly ash control equipment?

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Reverse-Jet Filters
HOLO-FLITE Processors

Western Precipitation Corporation

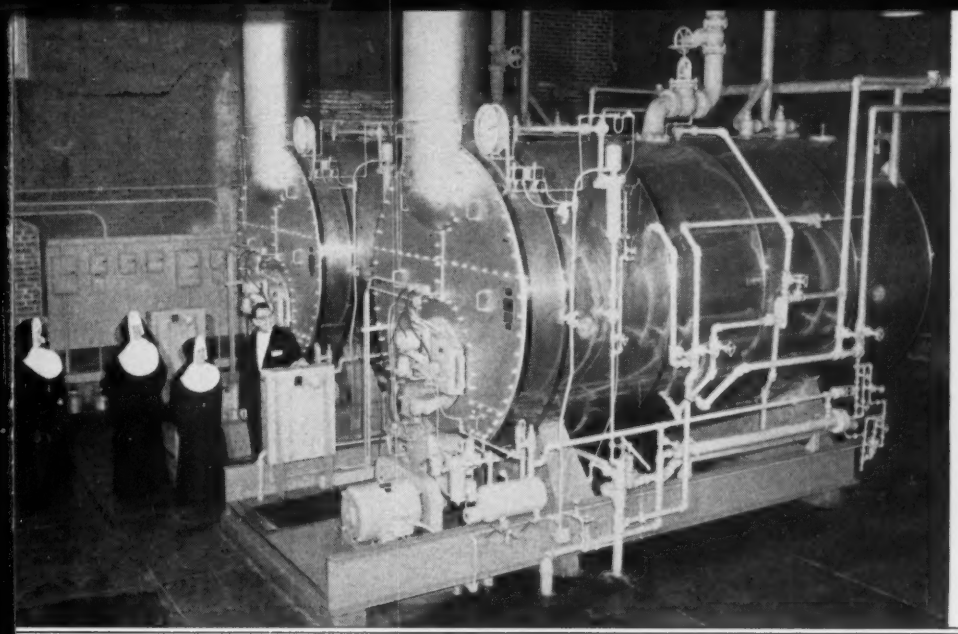
Designers and Manufacturers of Equipment for Collection of Suspended Material from Gases . . and Equipment for the Process Industries

Main Offices: **1049 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA**

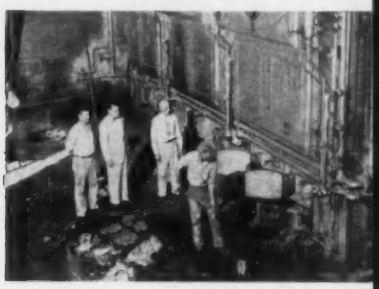
Chrysler Building, New York 17 • 1 North La Salle Street Building, Chicago 2 • Oliver Building, Pittsburgh 22 • 3252 Peachtree Road N. E., Atlanta 5 • Hobart Building, San Francisco 4

Precipitation Company of Canada Ltd., Dominion Square Building, Montreal

Representatives in all principal cities



NEW BOILERS combine efficiency and handsome appearance. Edward S. Green, Edgemont (Pa.), contractor, was responsible for this superior installation. Pictured left to right are: Sister M. Cor Immaculatum, Immaculata College Treasurer, Sister Jean Marie, Community Treasurer, Reverend Mother Maria Alma, Superior General and Salvatore S. Guzzardi, Consulting Engineer.



OLD BOILER was a coal-fired HRT model — typical of many replaced by modern Cleaver-Brooks oil, gas or combination oil/gas fired boilers.

Consulting engineer* tells how Immaculata College boiler modernization saves estimated $12,000 each year

Salvatore S. Guzzardi CONSULTING ENGINEER
2928 LEWIS TOWER · PHILADELPHIA 2, PA · KINGSLEY 6-2777

December 20, 1956

Mr. John C. Cleaver, President
Cleaver-Brooks Company

Dear Mr. Cleaver:

Recently our office was retained to make an impartial, exhaustive engineering study of the 40-year old boiler plant and steam system at Immaculata College, Immaculata, Pa., which is staffed by the Catholic order, Sisters of the Immaculate Heart of Mary.

As a result of our recommendations, two fully automatic, oil-fired, 350 bhp Cleaver-Brooks package steam boilers, (12,000 lbs/hr steam each), replaced three hand-fired coal boilers and steam-driven auxiliaries. The new boilers are operating at approximately 80% boiler efficiency year-round.

Conversion of coal firing to automatic #6 oil firing and increased boiler efficiency has reduced the fuel cost approximately 50% -- amounting to a saving of $12,000 each year.

The Cleaver-Brooks boilers burn #6 oil and operate automatically at 80 pounds steam pressure 'round the clock -- without the presence of operators in the boiler room. Eliminating boiler plant labor saves the College $7,500 each year.

The cost of the boiler plant modernization will be paid for out of fuel and labor savings in approximately 2-1/2 years.

Commendation for this outstanding performance of the Immaculata boiler plant is due to your well-engineered boiler design and to the cooperation of your skilled servicemen. The results achieved were so impressive that the Sisters subsequently modernized their Villa Maria Convent, Westchester, Pa., with two 100-bhp Cleaver-Brooks boilers.

Sincerely yours,

Salvatore S Guzzardi

Salvatore S. Guzzardi — Award-winning head of an organization of experienced professional engineers specializing in modernizing power service facilities. Clients include: Pennsylvania University, Baldwin-Lima-Hamilton Corp., H. Daroff & Sons, Sun Shipbuilding & Dry Dock Co. and City of Philadelphia.

Surveys show 32% of boilers now in service are 30 years old; 56% are over 20 years old

If your boiler fits this description, we recommend an immediate survey. "In 90% of the plants surveyed," summarizes Mr. Guzzardi, "we have found it possible to save thousands of dollars and to pay for the recommended improvements out of annual savings within one to three years."

Again and again the proved economy of Cleaver-Brooks four-pass, forced-draft boiler design results in savings reports as impressive as this. Contact your nearest Cleaver-Brooks representative for more facts on the complete line of steam and hot water boilers — 19 sizes, 130 models, 15 to 600 hp — for heating or processing. Or write Cleaver-Brooks Company, Dept. C, 301 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CLEBRO — Milwaukee — all codes

Cleaver Brooks

ORIGINATORS OF SELF-CONTAINED BOILERS

Engineers from Blaw-Knox and Arthur D. Little, Inc., make intermediate check on data as operator (on left) watches signals on control console of electronic computor

Power Piping Division develops

new "6 x 6" Flexibility Matrix Method —cuts calculation time from months to a day

Present day operating requirements demand power piping systems that can handle extremely high temperatures and pressures—often up to 4500 psi and 1100° F. Under these critical conditions pipe may expand as much as ten inches in a hundred feet of pipe.

To be sure of adequate flexibility of the piping system, the terrific stresses set up by this expansion must be accurately computed before fabrication. And these computations are often so complex that skilled stress analysts have had to take two to three months, sometimes more, to complete them.

Now, by using the Blaw-Knox "6 x 6" Flexibility Matrix Method, computation time is cut to one day.

Developed in an 18-month joint research project of the Blaw-Knox Power Piping Division and the Arthur D. Little, Incorporated, Cambridge, Mass., research consultants, this new method of computation takes advantage of the high speed and accuracy of electronic computers.

Results are: Completely automatic computation with no limitations on the complexity of the systems. Full accuracy—as any inconsistencies in the input data are detected by the machine and all results are carried to six significant figures. Tremendous saving in time. Highly profitable saving in costs.

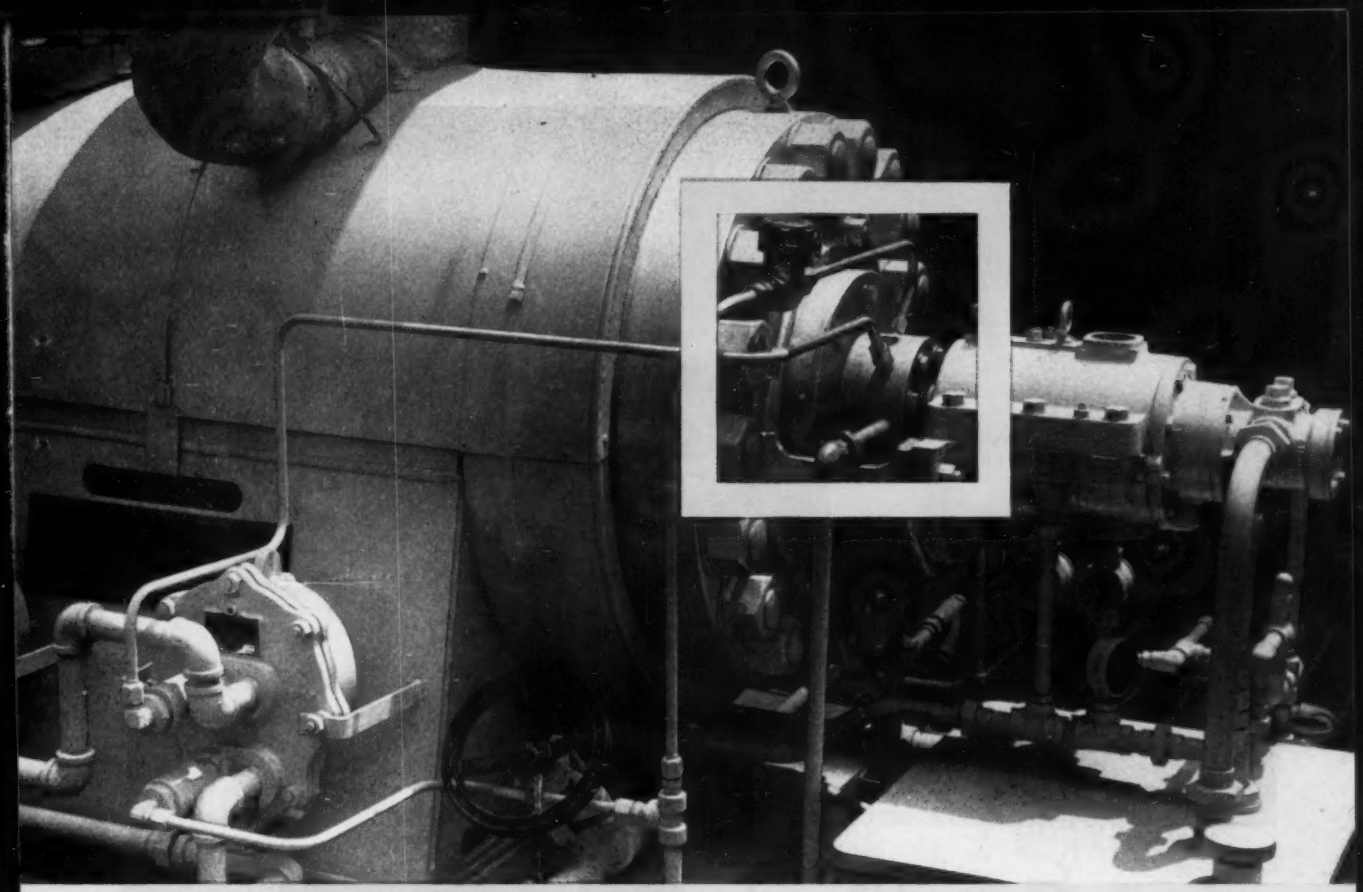
Originally developed for calculating stress analysis on systems fabricated or designed by Blaw-Knox Power Piping Division, this new method of computation is now available to consulting engineers, companies and individuals responsible for the design of power piping systems.

Bring your piping stress problems to our Power Piping Division for a discussion with our experienced piping engineers.

BLAW-KNOX

BLAW-KNOX COMPANY
Power Piping and Sprinkler Division
Pittsburgh 33, Pennsylvania

Complete facilities for prefabrication and erection of piping systems—complete line of functional spring hangers, assemblies and vibration eliminators—complete engineering and installation of Automatic Sprinkler Systems



City of Pasadena realizes

Big Savings on Boiler Feed with BJ Mechanical Seals

The City of Pasadena Light and Power Department has been using BJ Mechanical Seals in high temperature, high pressure boiler feed service for more than a year. These seals are installed on three double case boiler feed pumps with suction pressures to 400 psi, temperatures of 427° F. and an operating speed of 3550 rpm. The seals incorporate a pumping ring and small Graham Heliflow heat exchanger. Here are the results:

1. SAVINGS ON MAINTENANCE—Stuffingbox maintenance has been completely eliminated since installation of the seals. There has been no repacking labor cost... no pump shut-down loss.

2. SAVINGS OF TREATED FEED WATER—Previous to BJ Mechanical Seal installation, considerable loss of expensive, prepared feed water occurred. Now leakage loss is imperceptible.

3. SAVINGS OF HEAT—BTU's formerly lost through stuffingbox leakage are now sealed in for greater overall boiler feed operating efficiencies.

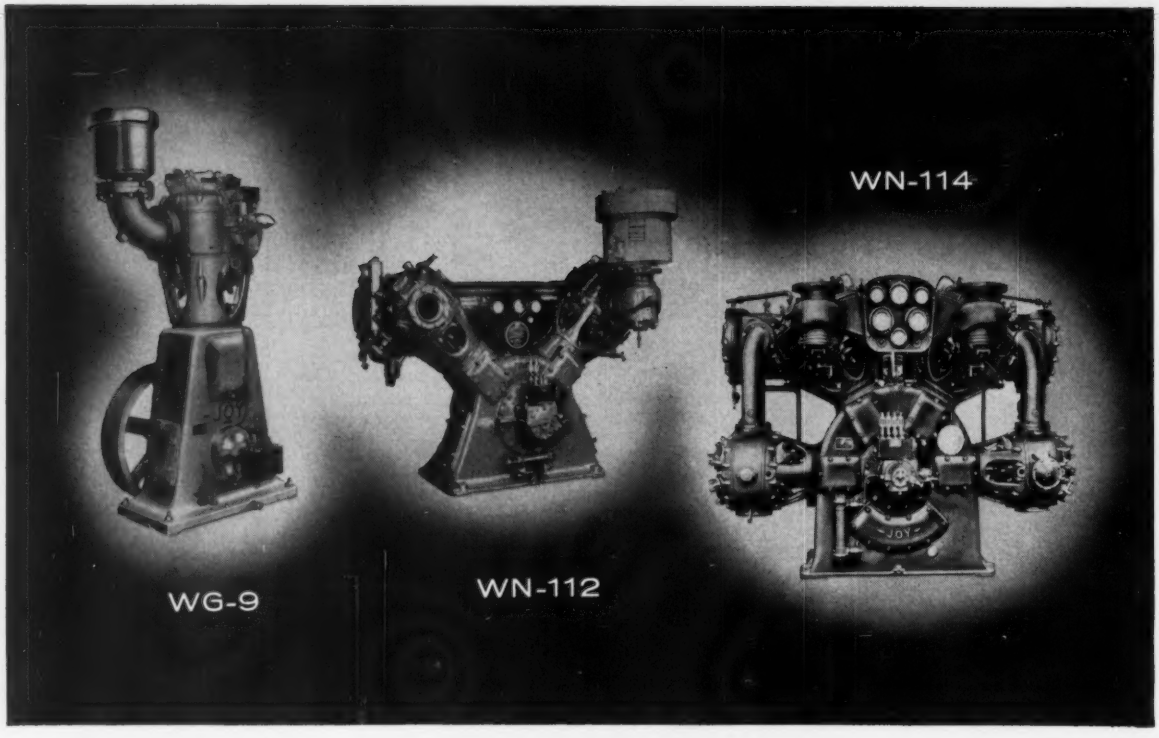
YOU CAN ACTUALLY COUNT THE SAVINGS IN LOWER COST OF KILOWATTS!

If you are operating high temperature, high pressure boiler feed pumps it will pay you to investigate now the big savings available from BJ Mechanical Seal installation.

Contact your BJ Pump Sales Engineer or write:

BYRON JACKSON PUMPS
INCORPORATED

A subsidiary of Borg-Warner Corporation
P.O. Box 2017A, Terminal Annex • Los Angeles 54, California



NEED TO *Expand* YOUR COMPRESSED AIR FACILITIES?

WRITE FOR THESE FREE BULLETINS ON JOY COMPRESSORS

JOY WG-9 • 15 to 75 Horsepower • 95.6 to 939 CFM

Single cylinder, single stage, double acting, water cooled. Joy vertical design saves space . . . fits right into plant expansion plans. Fourteen models. Bulletin shows cross-section diagram with construction and operation details.

JOY WN-112 • 60 to 150 Horsepower • 368 to 974 CFM

Two cylinder, two stage, double acting, water cooled. Joy pioneered the V-vertical design in 1936 . . . thousands of these units in operation. Nine models available. Bulletin gives complete details on construction and operation.

JOY WN-114 • 175 to 600 Horsepower • 1186 to 3896 CFM

Four cylinders, two stage, double acting, water cooled. Joy semi-radial design provides maximum capacity in very little space. Eight models. Bulletin gives complete construction details.

JOY MANUFACTURING COMPANY, OLIVER BLDG., PITTSBURGH, PA.

EQUIPMENT FOR INDUSTRIAL PLANTS...FOR ALL INDUSTRY

WRITE FOR BULLETIN SET 156-16

AIR & GAS COMPRESSORS

FANS AND BLOWERS

ELECTRICAL CONNECTORS

OIL FREE COMPRESSORS

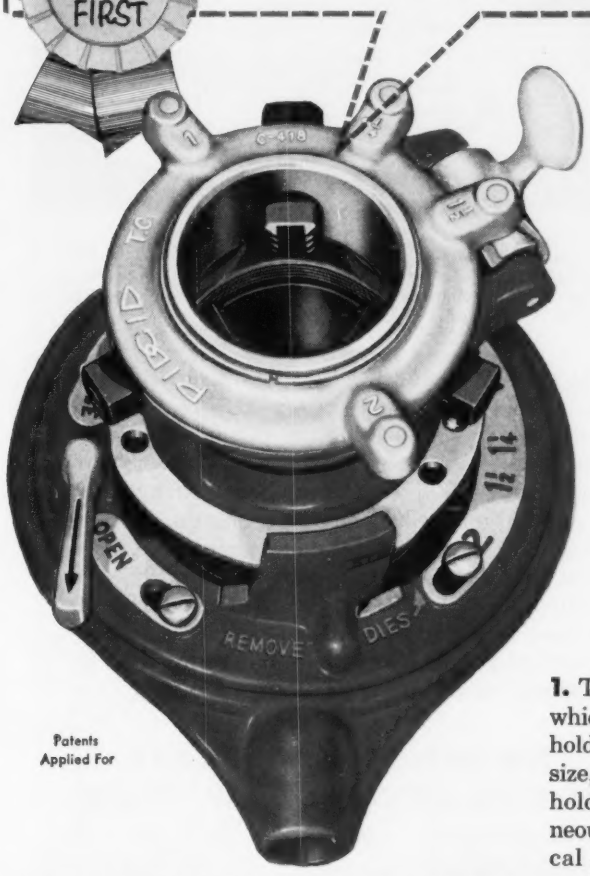
WSW 16471-156

Big News! RIDGID 65R

Now Has A Revolutionary New

True-Centering Workholder

Another RIDGID FIRST



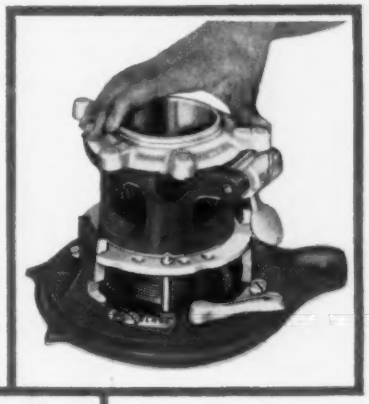
Patents Applied For

That Guarantees Always True Straight Threads

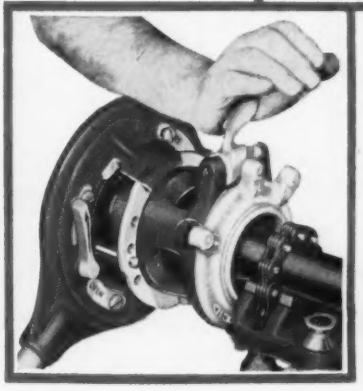
...even on over or under size pipe

Because All 3 Workholder Jaws Close At One Time!

Here's How It Works . . .



1. Turn cam plate which pre-sets workholder to desired pipe size, closes *all* 3 workholder jaws simultaneously by 1 mechanical action, for exact centering of die stock on pipe, even if pipe is over or under size.



2. When threader is on pipe, all 3 workholder jaws tighten in 1 action by bump of forged cam lever with palm of hand. Jaws grip and hold tight. Threads are *always* straight and true.

New TC Workholder fits your old 65R

. . . easy to change—ask your Supply House.

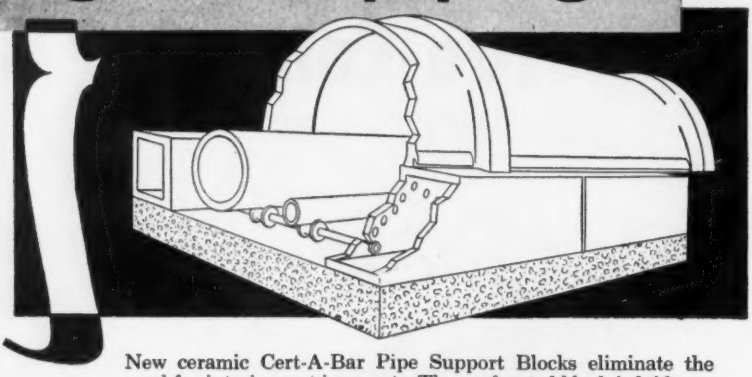
RIDGID 65R is jam-proof—kicks out automatically when standard thread is cut. Threads 1″ to 2″ pipe or conduit with 1 set of dies that stay in threader. Change from size to size in only 8 seconds. Instant workholder setting. With new TC workholder, 65R is far the most for your money—ask your Supply House today!

RIDGID
Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U.S.A.

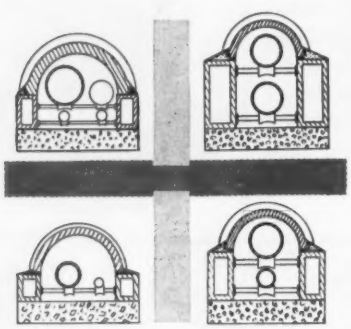
PERMANENT PROTECTION
for underground piping!

STILLWATER CERT-A-BAR* TUNNEL CONDUIT SYSTEM



New ceramic Cert-A-Bar Pipe Support Blocks eliminate the need for interior cast iron rests. The perforated block is laid as a structural support member at regular intervals, and the bars are simply inserted and locked in place.

THE vital consideration in selecting an underground conduit system is *permanent* protection . . . not for one year or five, *but for the life of the piping.* You get the best possible protection for your underground metal service piping with a Stillwater Conduit System of vitrified clay. It's chemically inert—can't rust, rot, corrode, or decay . . . ever. And it is manufactured in accordance with ASTM specification C-13-54, assuring proper strength and quality. Any combination of service piping can be protected. Conduit is available in a wide range of sizes, with a complete line of fittings and accessories, including alignment guides, lateral guides, and anchors. Any contractor's crew can handle the installation easily, or if you prefer, Stillwater Licensed Installers will assume the responsibility. The Cert-A-Bar Tunnel System can be installed with any of three suggested new waterproofing specifications —one for average conditions, one for intermittent ground water conditions, and a third for high water table conditions. It's the lowest-cost conduit per year of service that you can specify or install!



THE CERT-A-BAR SYSTEM HAS ALL THESE IMPORTANT ADVANTAGES

- Inherent structural strength for permanent protection
- Complete flexibility for design
- Minimum initial and long-term costs
- Quickly installed
- Keeps pipe insulation dry
- No electrolytic corrosion of piping
- No maintenance required

A few of the hundreds of possible combinations of piping for the Cert-A-Bar Tunnel System are shown at left.

WRITE FOR

illustrated, four-page circular with complete installation specifications.

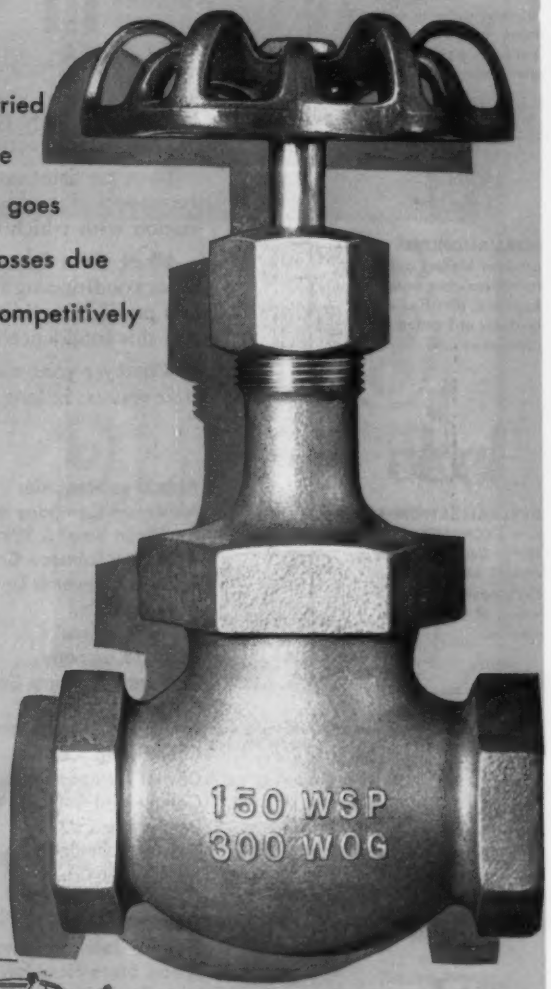
*T.M. Reg. App. For.
Patents Pending

The Stillwater Clay Products Co.
STILLWATER CONDUIT DIVISION
3334-F PROSPECT AVENUE, CLEVELAND 15, OHIO

STILLWATER
CONDUIT
SYSTEMS

END THOSE VALVE TROUBLES . . . NOW!

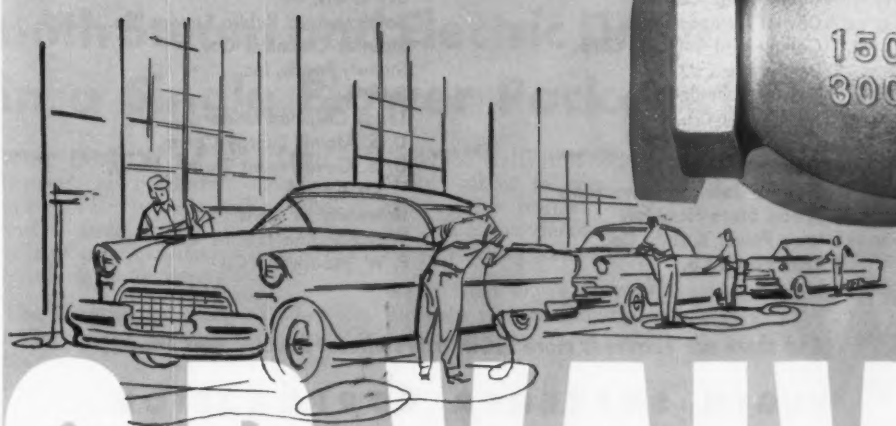
Are bronze valves a source of trouble in your maintenance program? Then you haven't tried O-B valves. Put them in your plant. Watch the maintenance job get easier as O-B quality goes to work. Notice the drop in production time losses due to valve troubles. O-B bronze valves are competitively priced. Ask your distributor about them.



4615-V

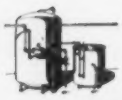
Ohio Brass

MANSFIELD OHIO, U. S. A.

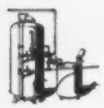


O-B VALVES

They have placed their trust in ELGIN!

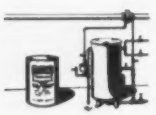


ZEOLITE WATER SOFTENER — manual and automatic. Up to 44% more soft water output from a softener of given size.

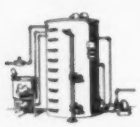


ULTRA-DEIONIZERS — produce highest quality mineral-free water. Replace distillation methods at fraction of distillation cost.

DEALKALIZATION & ION EXCHANGE SYSTEMS—Dealkalizers to control alkalinity. Ion Exchangers to produce water of any desired quality.



CHEMICAL TREATMENT SYSTEMS—prevent scale, corrosion and depositions with Elgin specially formulated chemicals.



CLARIFIER—for removing excess alkalinity and solids for clarification of turbid waters.

DEGASITORS—for removal of entrained gases from water by aeration.

The listing below reads like a roster of the Great Names of American Industry . . . but actually it is simply a partial list of Elgin users!

These are firms and institutions you know well . . . firms that have won the respect of the entire business world for the thoroughness and discrimination with which they choose equipment and services.

All of them have relied upon Elgin products and skill to meet their water conditioning needs . . . often critical and demanding requirements that posed complicated engineering problems. The records plainly show that this confidence in Elgin has been fully justified.

Whatever your water conditioning needs, it will pay you — in immediate results; in long range savings — to place *your* trust in Elgin.

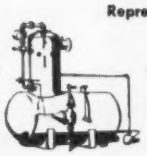
Abbott Laboratories
Aluminum Company of America
American Steel & Wire Co.
American Tobacco Co.
Arkansas Power & Light Co.
Armour & Co.
Bethlehem Steel Co.
Borden Company
California Packing Corp.
Campbell Soup Co.
Carnation Co.
Chemstrand Corp.
City of Denton, Texas
Commercial Solvents Corp.
Dr. Pepper Co.
Drewry's, Limited
Ford Motor Co.
General Electric Co.
General Mills
Howard Johnson Restaurants
Illinois State Hospitals
Iowa Power & Light Co.
Kraft Foods Co.
Kroger Grocery & Baking Co.
Liquid Carbonic Corp.
McDonald Aircraft Corp.
Monsanto Chemical Co.
Morrison Cafeterias
National Dairies
Neisner Brothers Inc.
Phillips Petroleum Co.
Quaker Oats Co.
Sinclair Refining Co.
Sisters of St. Francis Hospitals
Sky Chefs, Inc.
Southwestern Public Service Co.
Stauffer Chemical Co.
Stokely Foods, Inc.
Swift & Co.
Texas Christian University
U. S. Atomic Energy Comm.
U. S. Government (Army, Navy, Air Corps)
University of Iowa
Westinghouse Electric Corp.
F. W. Woolworth Co.

And there are hundreds more ELGIN users almost equally well known!

ELGIN SOFTENER CORPORATION

130 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities *In Canada: G. F. Sterne & Sons Ltd., Brantford*

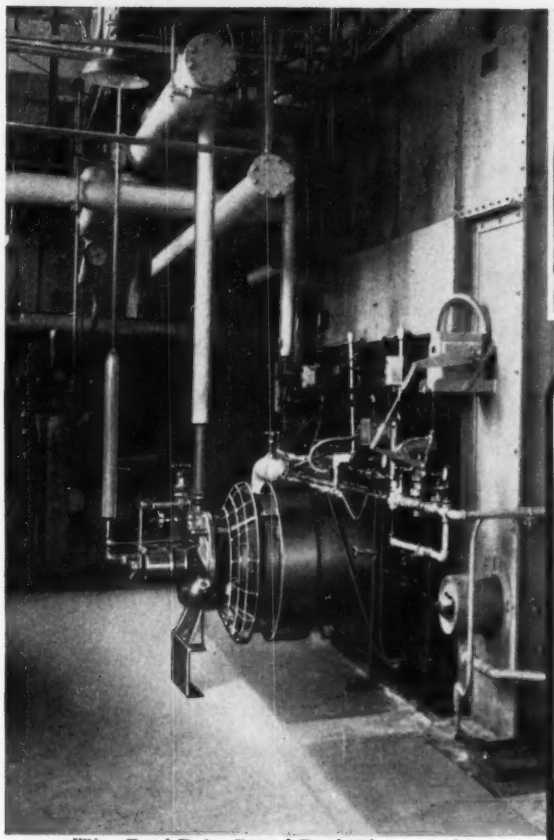


DEAERATING HEATERS—supply make-up water pre-heated by exhaust steam in which CO_2 and oxygen are eliminated.

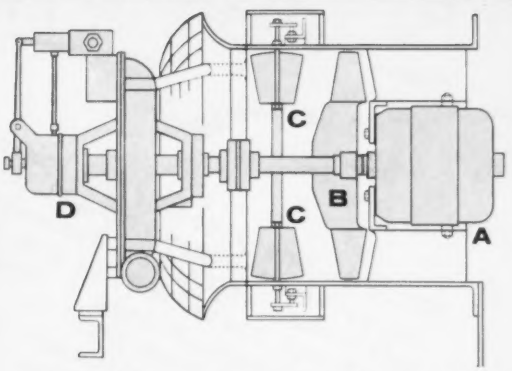
WATER FILTERS—Diatomite, sand, anthrafilt, activated carbon and oil removal filters in all types and sizes.

ELGIN WATER CONDITIONING SINCE 1908

WING DUAL DRIVE FORCED DRAFT BLOWERS



Wing Dual Drive Forced Draft Blower at the Easton, Pa. plant of the Dixie Cup Company.



Either the electric motor (A) or the turbine (D) drives the same fan (B) at constant speed. Inlet Voltrol Vanes (C) with external lever provide capacity regulation. To shift drives, simply push a starter button and turn a valve.

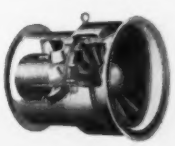
Both Steam and Electric Drive in a Single Blower Package

Wing Dual Drive Forced Draft Blowers are really two blowers in one. They provide both turbine and electric drive. The choice, at any time, is determined by heat balance or emergencies.

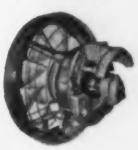
The Turbine drive is used when its oil-free exhaust is needed for feedwater, process or space heating . . . also in emergencies such as electric power failures. Precise draft control is obtained either manually or automatically. Motor drive is employed for starting up boilers or during periods of low demand for process or heating steam.

Wing Dual Drive Forced Draft Blowers are furnished in package form, completely assembled, ready for easy installation. Available for vertical or horizontal discharge. Send for engineering data, today.

Also available separately:



WING MOTOR DRIVEN FORCED DRAFT BLOWER



WING TURBINE DRIVEN FORCED DRAFT BLOWER

L. J. Wing Mfg. Co. 50 Vreeland Mills Road, Linden, N.J.

Factories: Linden, N. J. and Montreal, Canada

WING REVOLVING HEATERS

WING FRESH AIR SUPPLY HEATERS

WING FANS

WING TURBINES

WING DRAFT INDUCERS

Wing
DUAL DRIVE
BLOWERS

P-3

L. J. Wing Mfg. Co.
50 Vreeland Mills Rd., Linden, N. J.

Please send engineering data about Dual Drive Forced Draft Blowers.

Name.....

Firm.....

Address.....

City.....Zone.....State.....

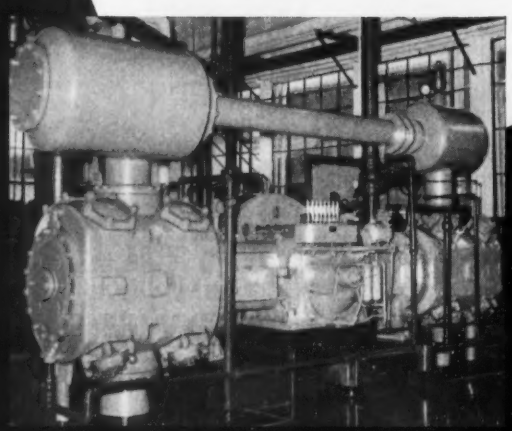
Gene:
Here's another excellent customer report of Cooper-Bessemer compressor performance.
Mike

*Excerpt from a letter written by the Plant Engineer of one of Firestone's foreign subsidiaries.

*This is one piece of equipment we are very happy to recommend to all prospective customers of Cooper-Bessemer. Since this unit was installed, it has operated over 13,800 hours, 6 days a week, 24 hours per day without down time for maintenance. It has given continuous service at rated capacity with no production stoppage or material spoilage.

Very truly yours,

Plant Engineer



Cooper-Bessemer motor-driven EM compressor in a tire manufacturing plant of The Firestone Tire and Rubber Company. This heavy-duty unit, rated 200 hp at 450 rpm, efficiently handles the compression of air from atmosphere to 100 psig.

BRANCH OFFICES: Grove City • New York
Chicago • Washington • San Francisco • Los Angeles
Houston • Dallas • Odessa • Pampa • Greggton
Seattle • Tulsa • St. Louis • Kansas City • Minneapolis
New Orleans • Shreveport • Casper

SUBSIDIARIES: Cooper-Bessemer of Canada, Limited . . . Edmonton • Calgary • Halifax.
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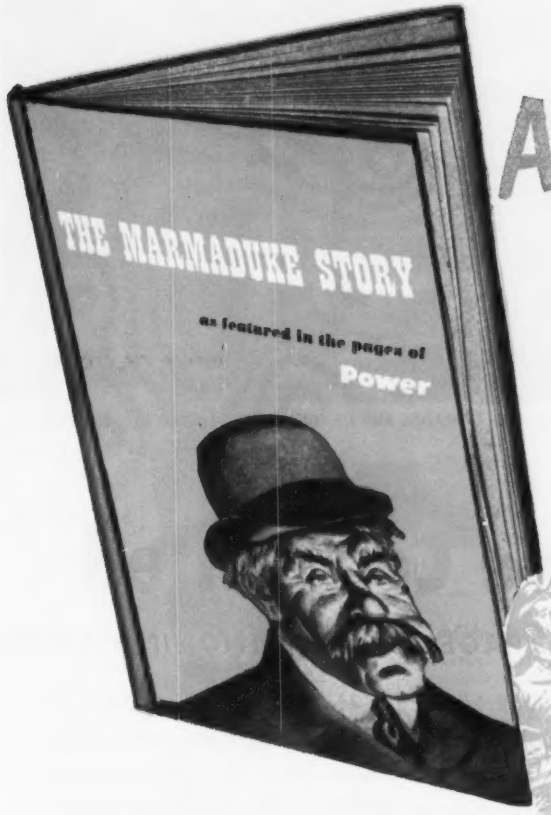
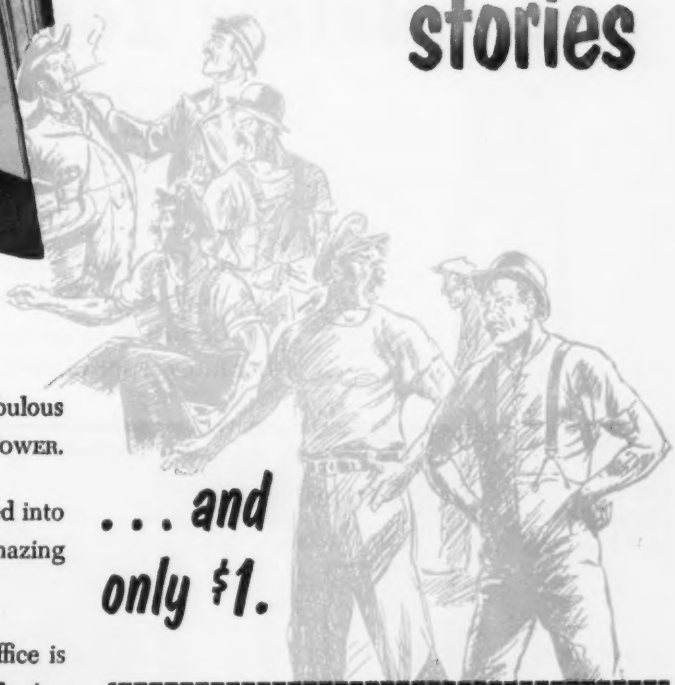
Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO



A SHIP LOAD of wonderful Marmaduke stories



Here are *twenty-one* of Marmy's most fabulous exploits, exactly as told in the pages of POWER.

Here is the cantankerous old sea dog turned into a consulting engineer, whose ingenuity is amazing but always possible and even plausible.

As POWER readers well know, Marmy's office is upstairs over O'Houlihan's Machine Shop & Engine Works, where the phone number is Hell's Kitchen 2-1876. But his principal hangout is in The Bent Propeller Bar, whose proprietor's name is Bedlam, and where you're likely to find Marmaduke meditating over a bottle of Sandpaper Gin.

We have good reason to think that Marmaduke Surfaceblow is about the best known character in the power field—maybe in all industrial journalism. Here are the stories that made him so, handsomely bound in a colorful varnished cover, only one dollar. Supply is limited. Order today.

. . . and only $1.

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330 West 42nd St.
New York 36, New York

Enclosed find_____for which please send postpaid_____copies of "The Marmaduke Story" at $1. per copy.

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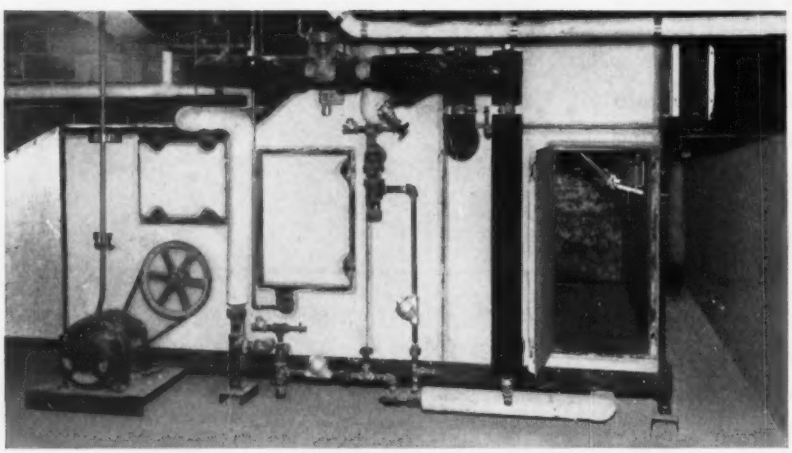
• ARCHITECTS AND ENGINEERS—Markus & Nocka • GENERAL CONTRACTOR—E. C. Blanchard Co. • HEATING AND AIR CONDITIONING CONTRACTOR—E. J. Devlin Co.

NEW HOSPITAL WING

Completely Zone Controlled

BY 7 CLARAGE AIR CONDITIONING UNITS

Plans for the new Garfield Morgan Memorial Wing to the Lynn Hospital at Lynn, Massachusetts called for complete air conditioning. As for so many other prominent installations, Clarage Blow-Thru Multitherm Units—seven of them—were selected. Here is equipment fully equal to the requirements of this important assignment. Quiet . . . economical in operation . . . and, most assuredly, dependable. CLARAGE FAN COMPANY, Kalamazoo, Michigan.



8 ZONES

This ONE Clarage Blow-Thru Multitherm Unit serves the specific air conditioning requirements of EIGHT different zones on the fourth floor which is the operating suite. Mixing dampers for each zone are interconnected so that the thermostat in each area controls the blending of hot and cold air to maintain the desired room temperature. Automatic damper operators can be seen through the open inspection door.

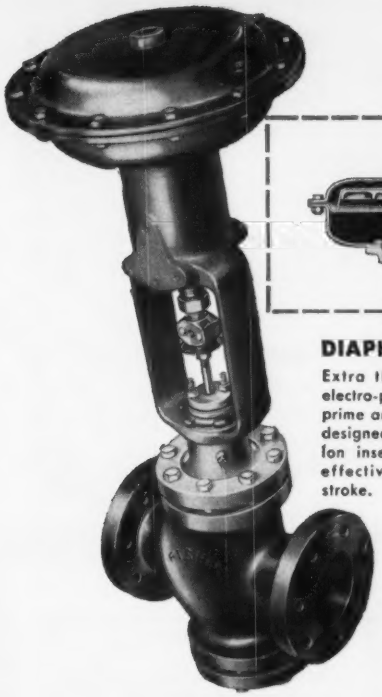
CLARAGE . . . *dependable equipment for making air your servant*

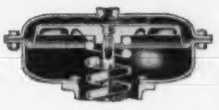
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

Any Way You Look At It

FISHER® Control Valves

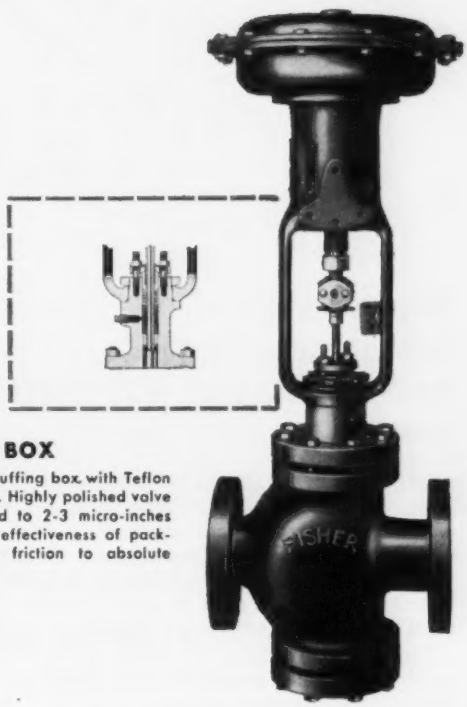
are your BEST BET!





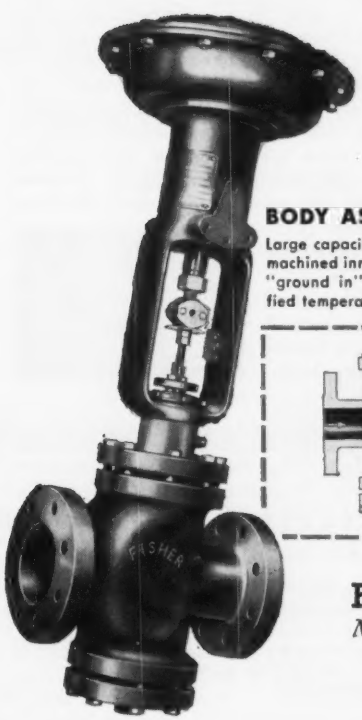
DIAPHRAGM ASSEMBLIES

Extra thick steel casings are zinc electro-plated, iridited and then given prime and final paint coats. Specially designed molded diaphragm with nylon insert gives practically constant effective area throughout valve stroke.



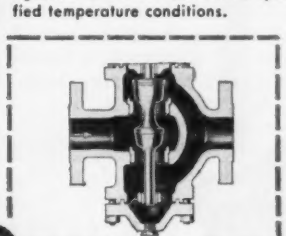
STUFFING BOX

Bolted gland stuffing box with Teflon V-Ring packing. Highly polished valve stem is finished to 2-3 micro-inches RMS to insure effectiveness of packing and keep friction to absolute minimum.



BODY ASSEMBLIES

Large capacity bodies with accurately machined inner valves are individually "ground in" under customer's specified temperature conditions.

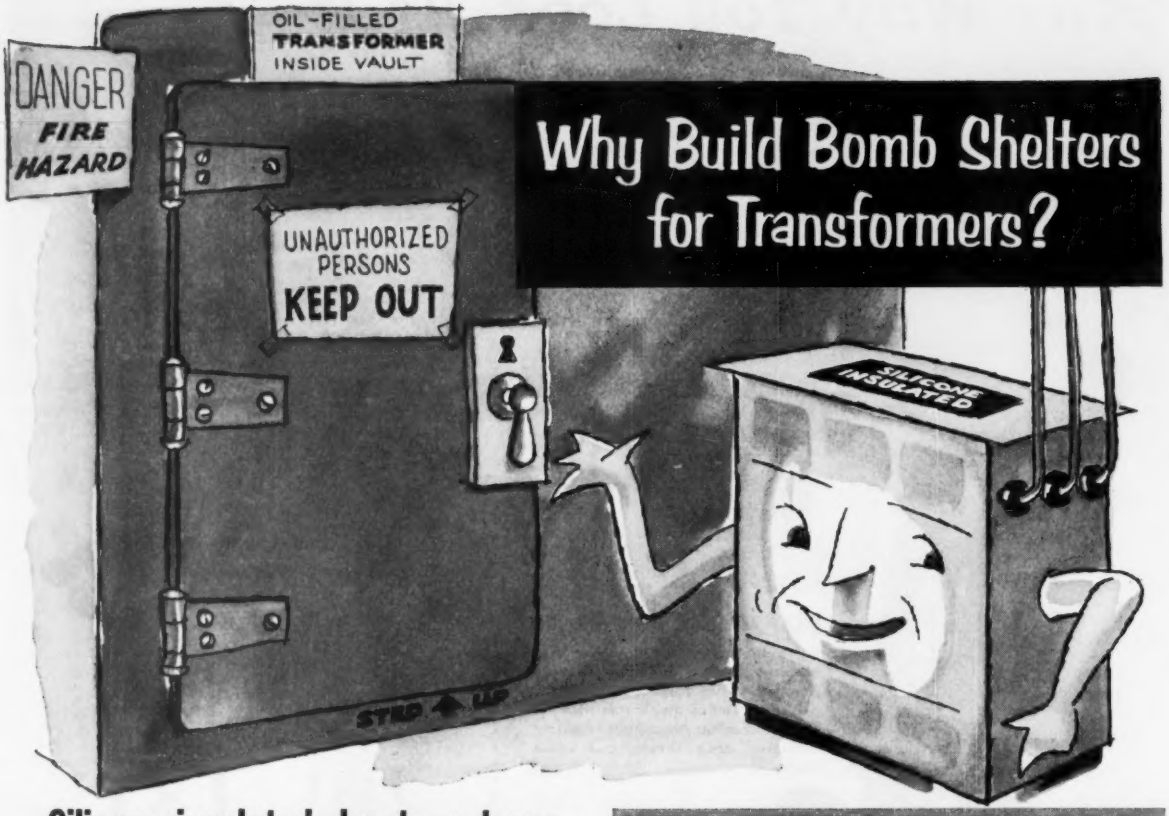


Realizing their importance in the control system, Fisher has given careful attention to design and construction of diaphragm control valves. Any way you look at it—from the standpoint of durable construction or accuracy of performance—Fisher Diaphragm Control Valves are your best bet.

FISHER GOVERNOR COMPANY

Marshalltown, Iowa • *Woodstock, Ontario*

World Leader in Research for Better Pressure and Liquid Level Control



Why Build Bomb Shelters for Transformers?

Silicone insulated dry-type transformers need no vaults, are safer, more reliable and less expensive.

SAFER . . . no explosion, fire or toxic hazards with silicone insulation.

MORE RELIABLE . . . silicone insulation is inherently more resistant to high ambients, heavy overloads, moisture and corrosive atmospheres.

LESS COSTLY . . . silicone insulation can harness more power per pound. That means smaller transformers that can be installed close to load anywhere in your plant saving space, copper and installation costs.

. . . your power distribution system is more efficient, more flexible and adaptable with silicone insulated dry-type transformers.

. . . silicone insulated dry-type transformers require no expensive vaults or special ventilating systems.

. . . your maintenance costs drop to almost nothing with silicone insulated dry-type transformers. All that's required is an occasional dusting — no liquids to replace or filter.

Mail coupon today for additional information.

Dow Corning Corporation, Dept. 6915, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

NAME _____ TITLE _____

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CITY _____ ZONE ____ STATE _____

DOW CORNING SILICONES

pt *your proof of reliability*

Where is there a more vital need for reliable transformer service than in a major commercial airport? The greater Fort Worth International Air Port uses two Pennsylvania Transformer Company units, both 1000 KVA, three phase, 60 cycles, 150 C rise. Insulated with Dow Corning Silicones, these dry-type transformers carry all power for Fort Worth's field and terminal lighting system. Silicone insulation was specified because it provides a greater guarantee to public safety; is more dependable, and has the overload capacity to handle emergency loads.

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

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CANADA: Dow Corning Silicones Ltd., Toronto
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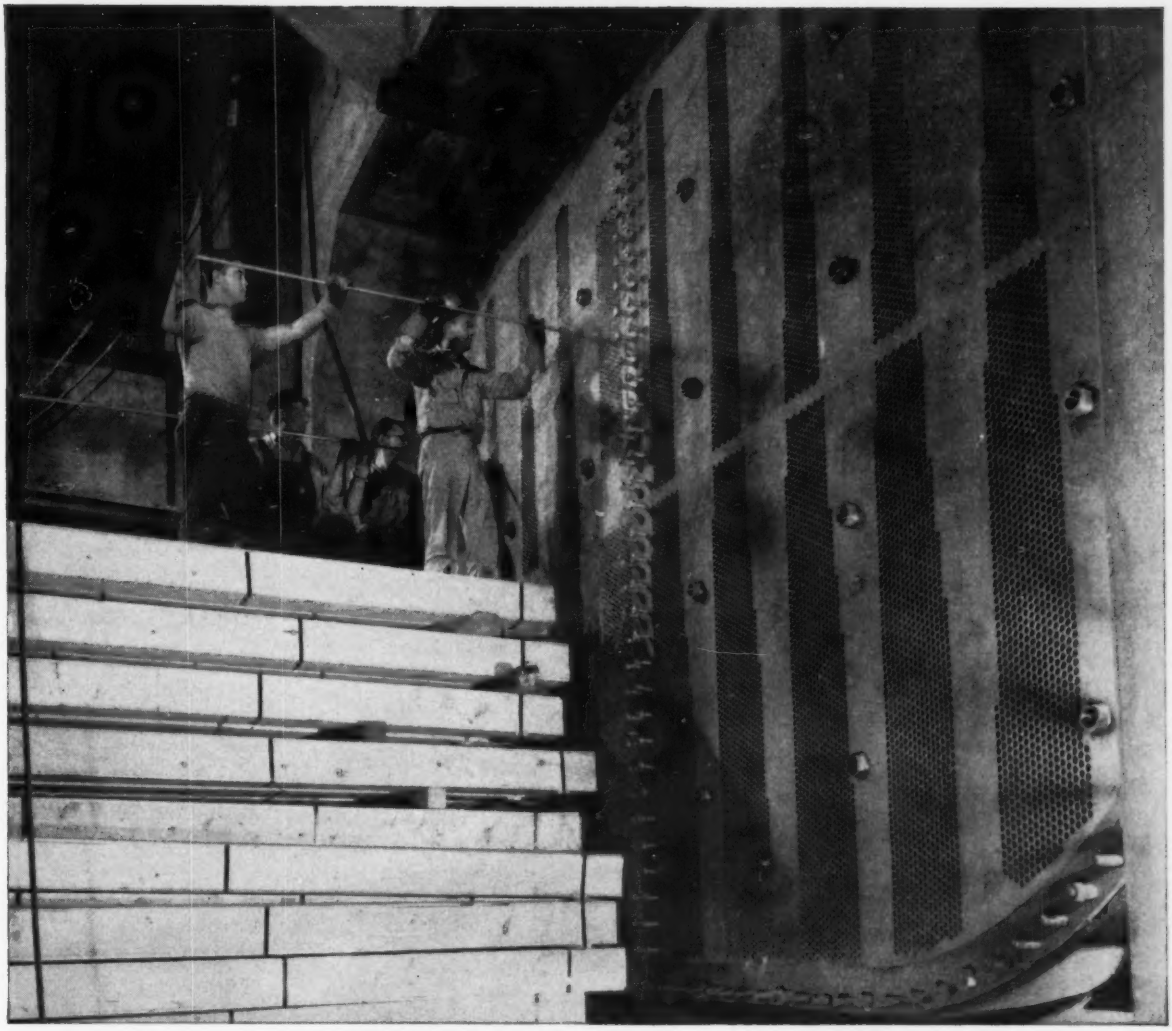


Wisconsin Electric Power Company chooses ALCOA ALUMINUM heat exchanger tubes for this big surface condenser

Saves over 50% on tube costs, reports excellent service

This 105,000 sq ft surface condenser at Wisconsin Electric's No. 3 power unit, Oak Creek, Wisconsin, is the result of more than four years of tests with ALCOA® Aluminum Heat Exchanger Tubes. It is believed to be the first utility company surface condenser of its size to be fitted with aluminum tubes. Development work was handled jointly by ALCOA, Allis-Chalmers and Wisconsin Electric engineers.

The project was started in 1950 when ALCOA Aluminum Tubes were spotted in various locations and later evaluated. Initial cost savings were evident at once. Cost studies proved aluminum tubes save more than 50% in initial costs compared to admiralty.

Aluminum's superior resistance to ammonia, carbon dioxide and hydrogen sulfide is important in avoiding corrosion in the air cooler sections of the condenser. This natural corrosion resistance and the valuable dollar savings afforded by aluminum weighed heavily in the final decision to use ALCOA Aluminum Heat Exchanger Tubes. Excellent performance of the aluminum tubing in continuous service since December, 1955, has proved that decision sound. Now Wisconsin Electric plans to use ALCOA Aluminum Tubes for a second unit to be placed in operation during 1957.

For more than 30 years, ALCOA Aluminum Tubes have been used successfully in condensers and heat exchangers. The Wisconsin Electric installation demonstrates why this general acceptance has developed—the excellent properties of aluminum alloys, ALCOA's cooperative research and development programs to establish sound applications, and industry's desire for a good product at a reasonable price.

For full information on ALCOA Aluminum Heat Exchanger Tubes, write to ALUMINUM COMPANY OF AMERICA, 808-C Alcoa Building, Pittsburgh 19, Pa.

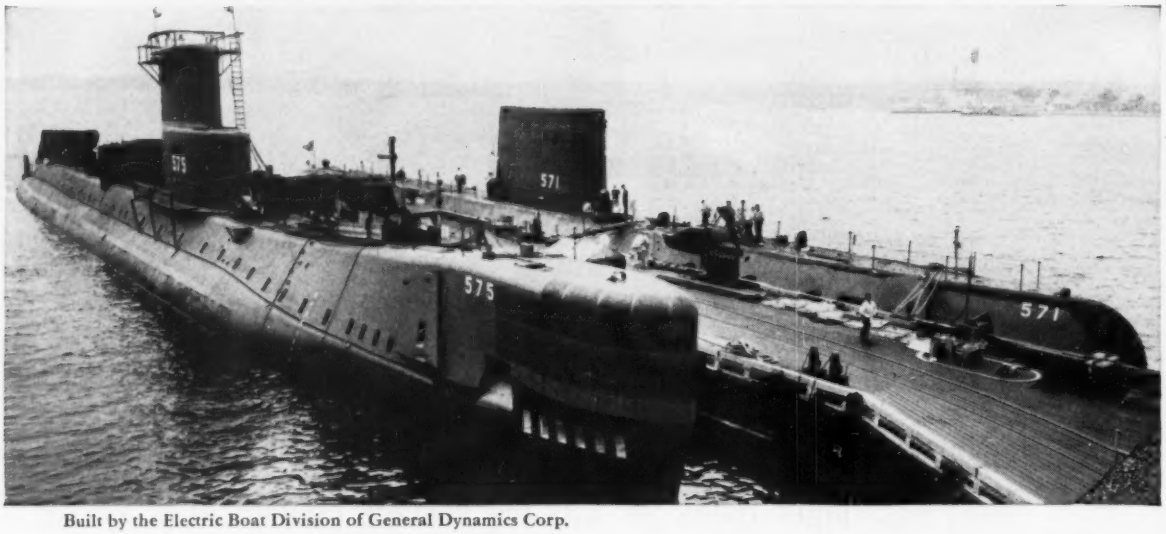
ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

On the USS Forrestal

Built by the Newport News Shipbuilding and Drydock.

On the USS Nautilus and Seawolf



Built by the Electric Boat Division of General Dynamics Corp.

Unibestos insulates vital pipe systems

Guardians of today's security and tomorrow's future—these are the ships of electronic devices and nuclear power...the products of advanced engineering and modern materials.

Aboard these ships, where dependability is a must, Unibestos pipe insulation protects intricate and vital pipeline systems against crucial heat loss. Unibestos makes a clean sweep in its contribution to this important Navy development program.

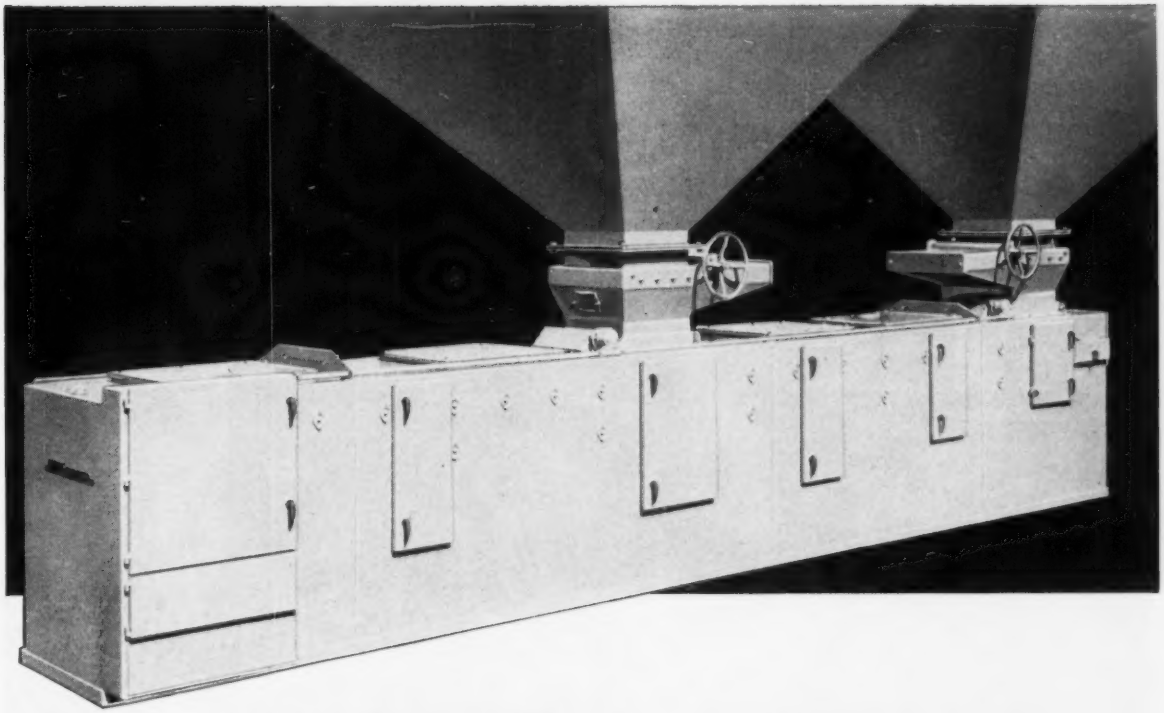
In fact, Unibestos is fast becoming the preferred insulation for an increasing number and variety of applications. Whether it's a ship, a refinery or a power plant, *single-layer* Unibestos combines high thermal efficiency with superior strength and unmatched ease of installation.

Unibestos® pipe insulation is available in sectional form through 44″ O.D. For further information without obligation, write for the free descriptive bulletin 109C.

UNARCO

UNION ASBESTOS & RUBBER COMPANY

1111 West Perry Street • Bloomington, Illinois



This Stock Equipment Company *Long Center* Scale Was Built to Order

Stock Equipment Company has specialized in Bunker to Pulverizer Feeder Equipment for over 25 years. During that time, every piece of S-E-Co. equipment has been designed and built for a specific application and installation. It is this specialization, plus great attention to detail, that makes the difference between merely satisfactory operation and trouble-free, dependable, accurate S-E-Co. operation.

When you order a S-E-Co. Coal Scale, Coal Valve, Coal Distributor, Paddle Type or the new Turn Counting Type Coal Stoppage Alarm, you know that it will be custom built especially for you. From the inquiry through to the actual installation, Stock Equipment Company works with you to make sure that the job is done properly so that you get the utmost in service out of your equipment.

Of course, this kind of planning and follow through costs more, but you will find that the reliability and long, trouble-free life is worth far more than the extra cost involved. If you are designing or building a new power plant or enlarging or modernizing an old one, take advantage of available information on the best in Bunker to Pulverizer Feeder Equipment by writing Stock Equipment Company, 745 Hanna Building, Cleveland 15, Ohio.

SPECIALISTS IN
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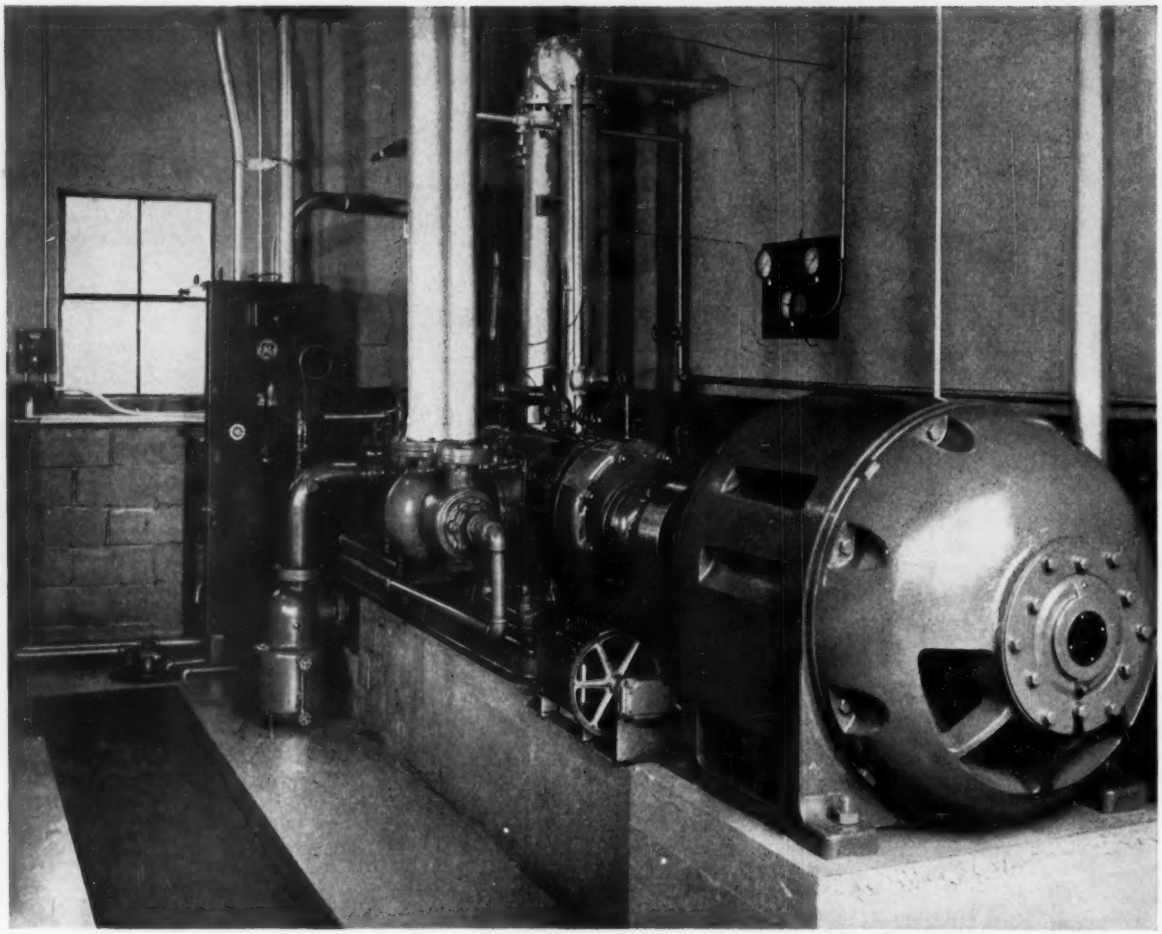
STOCK Equipment Company

CLEVELAND 15, OHIO



Fuller Rotary Two-Stage Compressor, C135-135H. Capacity 680 c.f.m., 100-lb. pressure, 690 r.p.m., 150 hp. motor.

16,000 HOURS OF OPERATION WITH NO MAINTENANCE

Empire Steel Castings, Inc., Reading, Pennsylvania, installed a C-135-135H Fuller Rotary Two-stage Compressor in April 1953. After 32 months—approximately 16,000 hours of operation—the compressor received a routine inspection, when a new set of blades was installed in the higher-pressure cylinder.

The Empire engineers report no downtime since replacement, although they've added 4,000 operating hours. Prior to switching to Fuller, their former experience with compressors was a different story—as many as several overhaulings in one year. With Fuller equipment furnishing a constant high capacity air supply, production costs have been greatly reduced.

Here's how Empire uses compressed air:

- In the molding department, supplying all air for pneumatic rammers, all squeeze and jolt machines, automatic set-out and lifting apparatus of mold conveyors, automatic shake-out machines, mold cleaning and spraying equipment.
- In the core department, for ramming equipment, spraying and torch drying equipment, core oven operation as well as core blowing equipment.
- In the cleaning department, pneumatic chipping hammers and grinders, blacksmith requirements, sand-blasting, pressure testing and miscellaneous tools.
- In the heat-treating department, heat treating furnace operation and cooling equipment.

To get all the facts and engineering data, write today for Bulletin C-5A.

C-298
3662

FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
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Fuller

PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

use steam efficiently, economically—choose the trap with . . .

just one moving part

. . . for easy maintenance

After all, a steam trap *should* be simple. Its job of discharging condensate and air from steam lines and equipment, is a simpletone. But its importance shouldn't be overlooked. On its effectiveness can rest your economical use of steam . . . the efficiency of your process operations.

With Nicholson steam traps there's just one moving part. Nothing to go wrong. But with all their simplicity, Nicholson traps have the greatest capacity of any trap their size. Plenty of other important features, too, and it'll be well worth your while to check them.

- **Powerful valve action**
- **Tight, positive shutoff**
- **No dribbling, no steam waste**
- **Each unit service tested**

Specify Nicholson, and be sure.

Write today for new Bulletin 10-55

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TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

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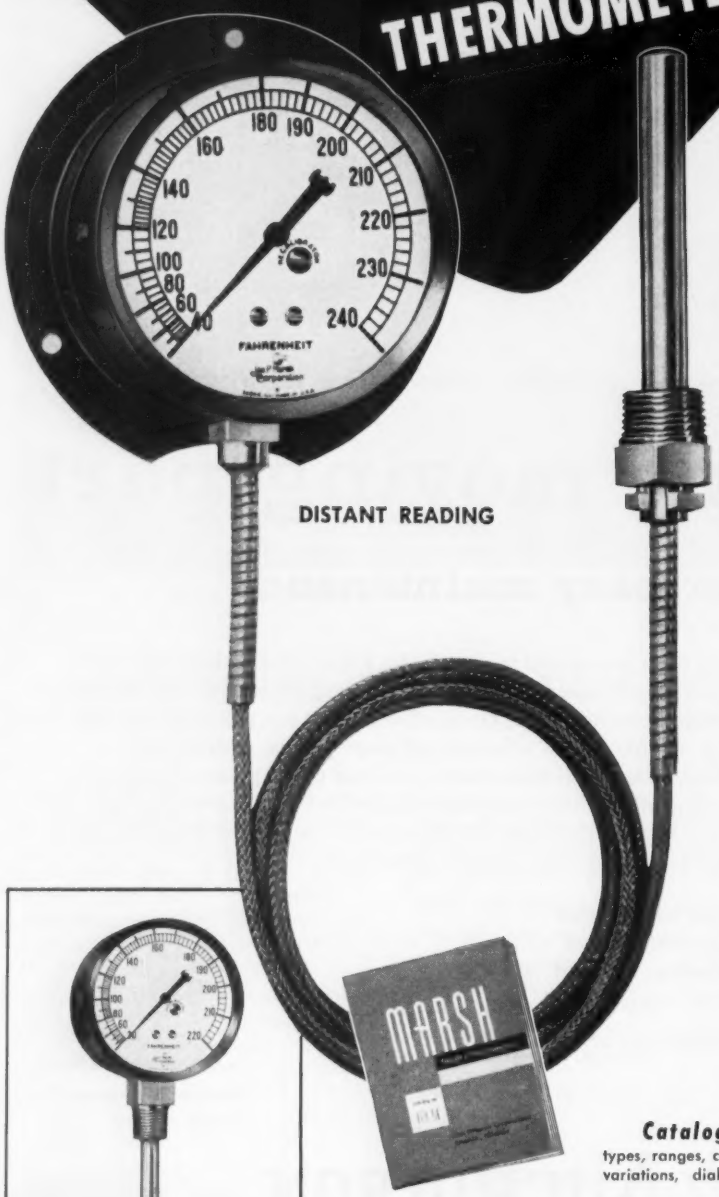
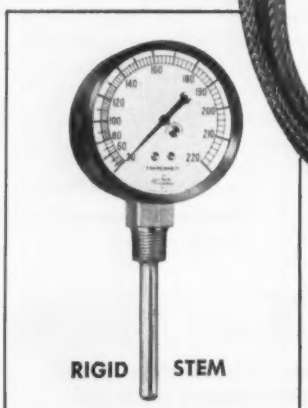
MARSH

Vapor Tension DIAL THERMOMETERS



DISTANT READING



RIGID STEM

Wider range of application

...TIME PROVED MARSH QUALITY

The best of all we have learned in 90 years of instrument making has gone into Marsh Dial Thermometers. They are the versatile, vapor tension type—the type that covers the widest range of needs . . . brought to the highest stage of development in the broad Marsh line.

Ambient temperatures have no effect on dial readings of Marsh Vapor Tension Thermometers. Therefore no compensating adjustments are ever needed. The distant reading type will give highly accurate readings even when located far from the point of temperature measurement. All thermometers have the famous Marsh "Recalibrator"—quickest and best way to keep an instrument accurate.

The Marsh line is the most complete line: Rigid stem thermometers are available in dial sizes of 2½", 3½" and 4½"; distant reading types in sizes of 2", 2½", 3½", 6", 8". All are made in 12 different ranges reading as low as —40° F. and as high as 350° F., and in scale lengths to cover all services. An outstanding contribution to their practical application is the wide range of bulb types available to suit all services. Cases are available in patterns for all mountings and in black steel, polished brass, nickel and chromium plate. All Marsh Thermometers are available with either fahrenheit or centigrade scales.

Catalog covers all details—
types, ranges, case patterns, dimensions, bulb variations, dial graduations. Write for it.

MARSH INSTRUMENT CO., *Sales affiliate of Jas. P. Marsh Corporation*
Dept. F, Skokie, Ill.

Marsh Instrument & Valve Co., (Canada) Ltd. • 8407 103rd Street, Edmonton, Alberta, Canada

Over 250,000 fibers of glasslike iron silicate guard each cross-sectional square inch of wrought iron pipe against corrosion

Wrought Iron Pipe pays off in years of service rendered

There's a practical, dependable way to evaluate a piping material's potential in corrosive service: check its performance under actual field conditions.

The photo above shows how wrought iron pipe measures up when this service-life yardstick is applied. Here you see actual samples taken from wrought iron pipe installations in a variety of corrosive services. Some of these sections came from buildings that were being torn down. Some were cut from in-use installations by our laboratory staff.

The reasons why wrought iron pipe has lasted so long and remained in such excellent condition are found in the material's structure and composition. Tiny fibers of glasslike iron silicate are threaded throughout the body of high-purity iron. These non-rusting fibers are highly resistant to corrosive attack. When corrosion strikes, these fibers halt and detour the attack, prevent rapid pitting and penetration.

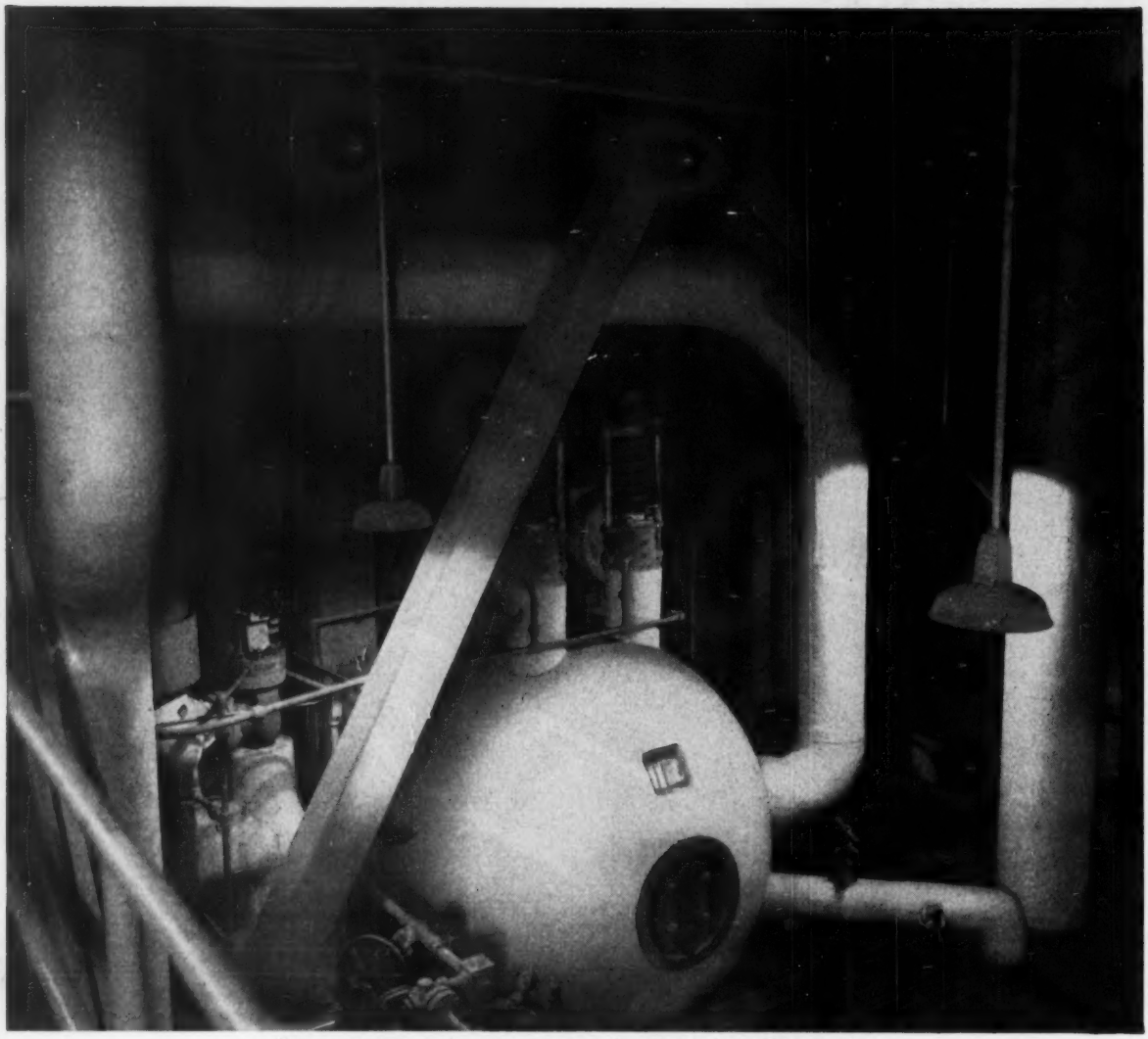
Our bulletin, *Piping for Permanence*, presents in detail wrought iron pipe's case against corrosion. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Pittsburgh, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N.Y.

Available in Canada and throughout the world

BYERS Wrought Iron Tubular and Hot Rolled Products

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS



Modern plant, modern insulation! In this new, up-to-date plant the boiler drum and piping pictured are insulated with K&M Hy-Temp Combination insulation for temperatures up to 1900° F.

Keep heat where it pays—use

K&M HIGH-PRESSURE INSULATIONS

On the toughest heat-saving jobs, these K&M High-Pressure Insulations cut waste, save you money, and give more precise process control.

Temperatures to 1900° F. call for K&M Hy-Temp Combination Insulation... a layer of diatomaceous silica overlaid with K&M "Featherweight"® 85% Magnesia. Joints are staggered to prevent heat loss through expansion-caused openings.

Temperatures to 600° F. call for K&M "Featherweight" 85% Magnesia, made of basic carbonate of magnesia and asbestos fiber. And K&M "Featherweight" 85% Magnesia is good for the life of the equipment it serves.

For information contact your K&M distributor, who is an experienced applicator. Or write directly to us.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

In Canada: Atlas Asbestos Company, Ltd.; Montreal, Toronto, Winnipeg, Edmonton, Vancouver

K&M best in asbestos®

Unretouched photo of dissolved oxygen attack in steam condensate return lines.

DEPOSIT OF NO RETURN

The "growths" you see on the interior of this condensate return line are known as tubercles. Beneath each tubercle is a cavity or pit in the metal surface—the result of concentrated, localized attack by the corrosive water. Water containing dissolved oxygen has converted metal on the pipe's interior to iron oxide, causing a buildup of corroded material. The velocity of the water flowing through the line is not sufficient to remove the tubercles, so they continue to grow larger and larger.

Dearborn's FILMEEN* prevents this corrosive attack by forming a continuous, monomolecular film on the interior surface of the pipe, protecting it against both oxygen and carbon dioxide corrosion. FILMEEN provides a protective, non-wettable barrier between treated steam, or condensate, and metal pipe surfaces.

FILMEEN is only one of many Dearborn water conditioning products scientifically developed to control specific corrosion problems. Others eliminate scale, sludge, carry-over, and similar difficulties.

Power engineers in leading industrial and commercial plants place their confidence in Dearborn's 70 years of experience in water chemistry. They have found the answer to the demand for complete plant protection in Dearborn Supervisory Service—a properly balanced water conditioning program which combines quality products with correct, technically supervised control methods and test procedures.

Let a Dearborn Engineer survey your plant and recommend the type of water control program best suited to your requirements.

Illustrated Booklet gives all the facts on Dearborn Water Conditioning Program. The coupon is for your convenience.

**FILMEEN is the trade-mark of a corrosion-inhibiting compound patented and produced exclusively by Dearborn Chemical Company. U. S. Pat. No. RE 23614.*

Dearborn®

...a leader in water conditioning and corrosion control since 1887

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PO, Chicago 54, Ill.

Gentlemen:

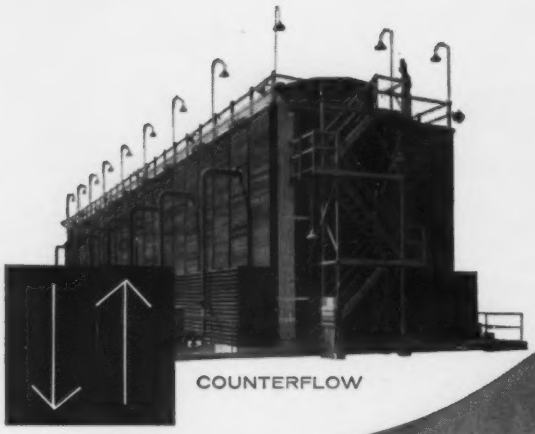
☐ Send my copy of Dearborn Water Conditioning Program.
☐ Have a Dearborn Water Treatment Engineer call.

Name.....

Company.....

Address.....

City.....*Zone*.....*State*.....

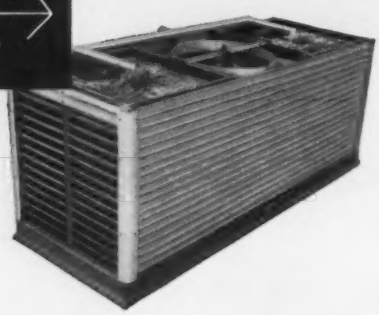


COUNTERFLOW

Pritchard

HEAVY-DUTY COOLING TOWERS

CROSSFLOW



Pritchard

LOLINE® COOLING TOWERS

WHATEVER YOUR COOLING TOWER REQUIREMENTS... YOU GET MORE FROM PRITCHARD!

Whether you need a large, heavy-duty industrial cooling tower or a smaller LOLINE crossflow tower for industrial processes or air conditioning service, you can look to Pritchard because Pritchard makes both!

Both have many outstanding, exclusive features. (For example, the extremely low silhouette of the LOLINE; the patented design of the fan blade on the industrial towers.) Both offer you guaranteed performance. Both give you more for your cooling tower dollar. Consult with your nearest Pritchard representative (his name is in the classified section of the phone book) or write direct and find out why you always get more from Pritchard.

Two Free Brochures Tell the Whole Story!

A note to Pritchard on your company letterhead is all it takes to get your free copies of the new, LoLine Brochure (gives all the details you will want on Pritchard's low silhouette crossflow towers) and "The Answers to 15 Questions About Pritchard Industrial Cooling Towers" (the inside story of Pritchard counterflow towers). There's no cost or obligation, so write today!

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GAS & AIR TREATING EQUIPMENT

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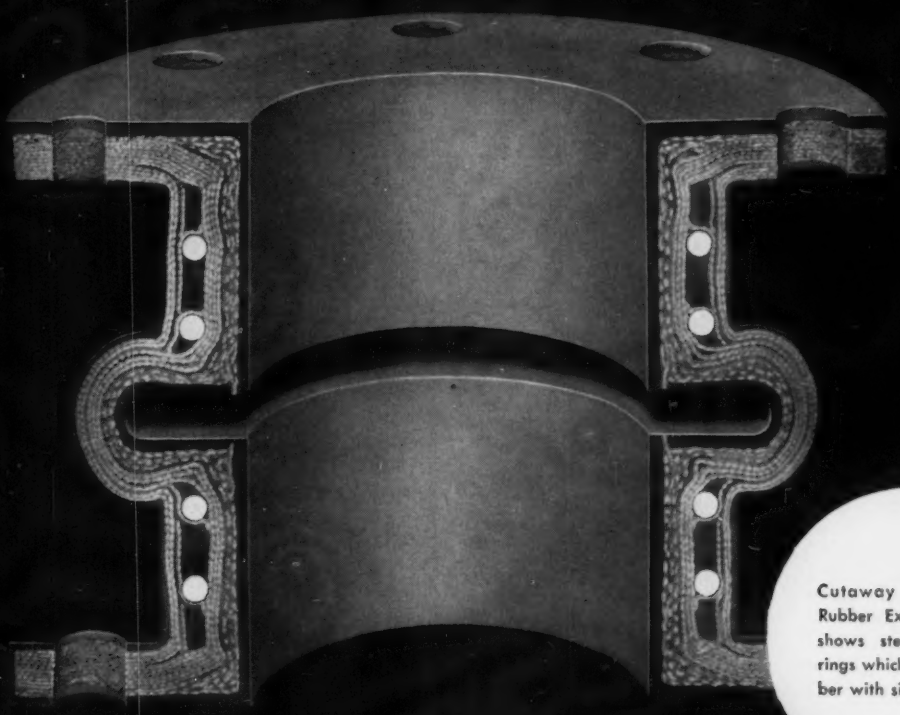
MORE OF THE GARLOCK 2,000



Cutaway of Garlock Rubber Expansion Joint shows steel reinforcing rings which vary in number with size of joint.

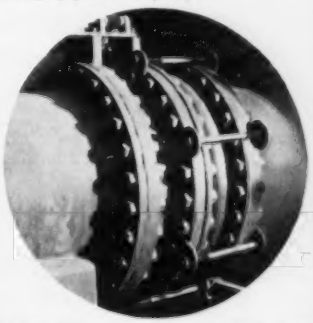
CORRECT VIBRATION, NOISE and FLANGE BREAKAGE...

GARLOCK RUBBER EXPANSION JOINTS are made from high-grade rubber, combined with plies of sturdy cotton duck and reinforced with steel rings. Practically any size or type expansion joint is available for service handling any liquid or gas. For example:

TYPE	USE
Rubber Expansion Joints (Spool-type, U-type, Tapered, Offset)	Hot or cold water Mild acids or caustics Brine, air, exhaust steam
Neoprene Expansion Joints	Oil Other Petroleum Derivatives
Teflon*-lined Rubber Expansion Joints All-Teflon Bellows-type Expansion Joints	Strong acids and caustics Halogenated Solvents Pure Foods

Rubber Expansion Joints are another important part of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. The *only* complete line. That's why you get *unbiased* recommendations from your Garlock representative. Call him or write for Rubber Expansion Joint Folder AD-137.

Garlock Expansion Joint on 2½" suction and discharge pipes of oil pumps.



Garlock Expansion Joint on 30" pipe line connecting propeller-type circulating water pumps.

THE GARLOCK PACKING COMPANY, Palmyra, New York

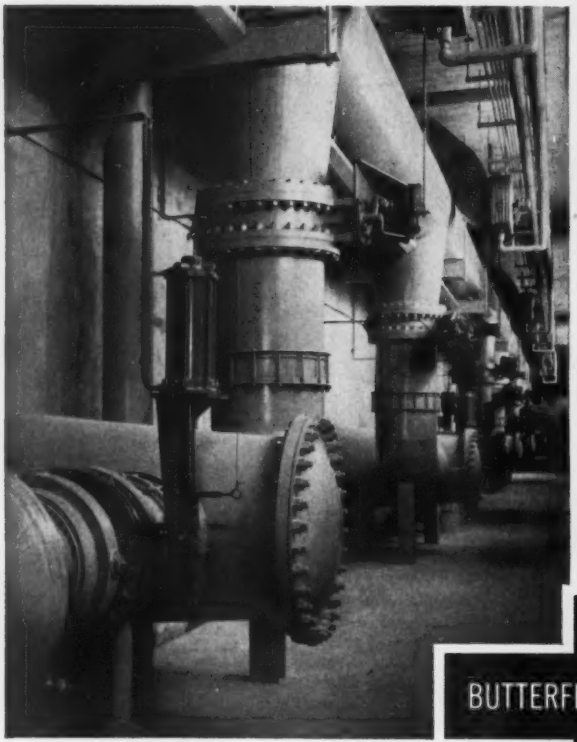
For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

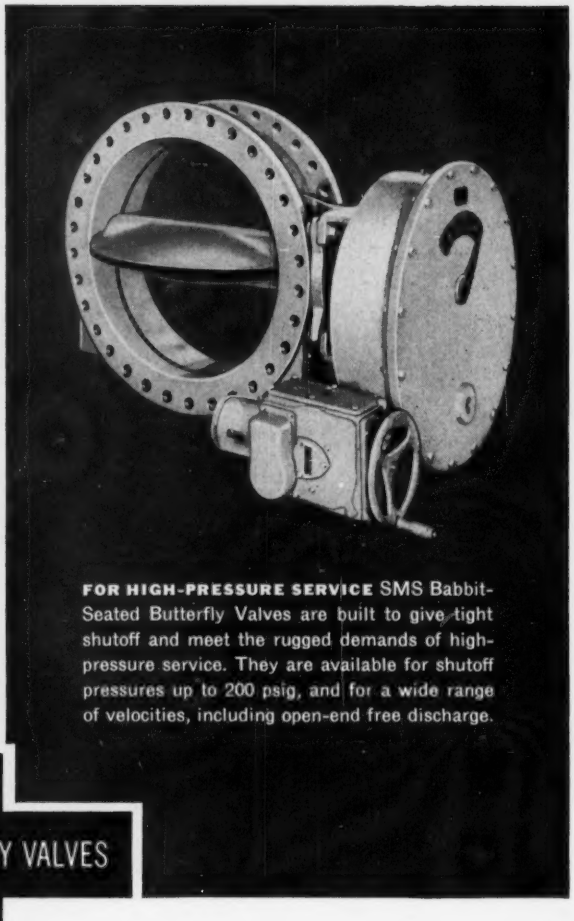
*DuPont Trademark

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products

DROP-TIGHT SHUTOFF R-S Rubber-Seated Butterfly Valves give drop-tight closure to 125 psig through wedge-type action of the disc within a one-piece rubber seat. 65 of these valves, installed as shown for service in the San Jacinto River project near Houston, gave a substantial space reduction and direct, in-place cash savings of $124,000.





FOR HIGH-PRESSURE SERVICE SMS Babbit-Seated Butterfly Valves are built to give tight shutoff and meet the rugged demands of high-pressure service. They are available for shutoff pressures up to 200 psig, and for a wide range of velocities, including open-end free discharge.

BUTTERFLY VALVES

GET POSITIVE SHUTOFF, CUT CONSTRUCTION COSTS

For high or low-pressure water service, SMS has the Butterfly Valve to give you tight shutoff and help reduce construction costs. Using SMS or R-S Butterfly Valves in place of conventional gate valves permits a much more compact piping layout, means substantial savings in the initial building costs. For full information on the complete SMS valve line – Butterfly Valves, Ball Valves and Rotovalves – see our local representative or write S. Morgan Smith Co., York, Pa.

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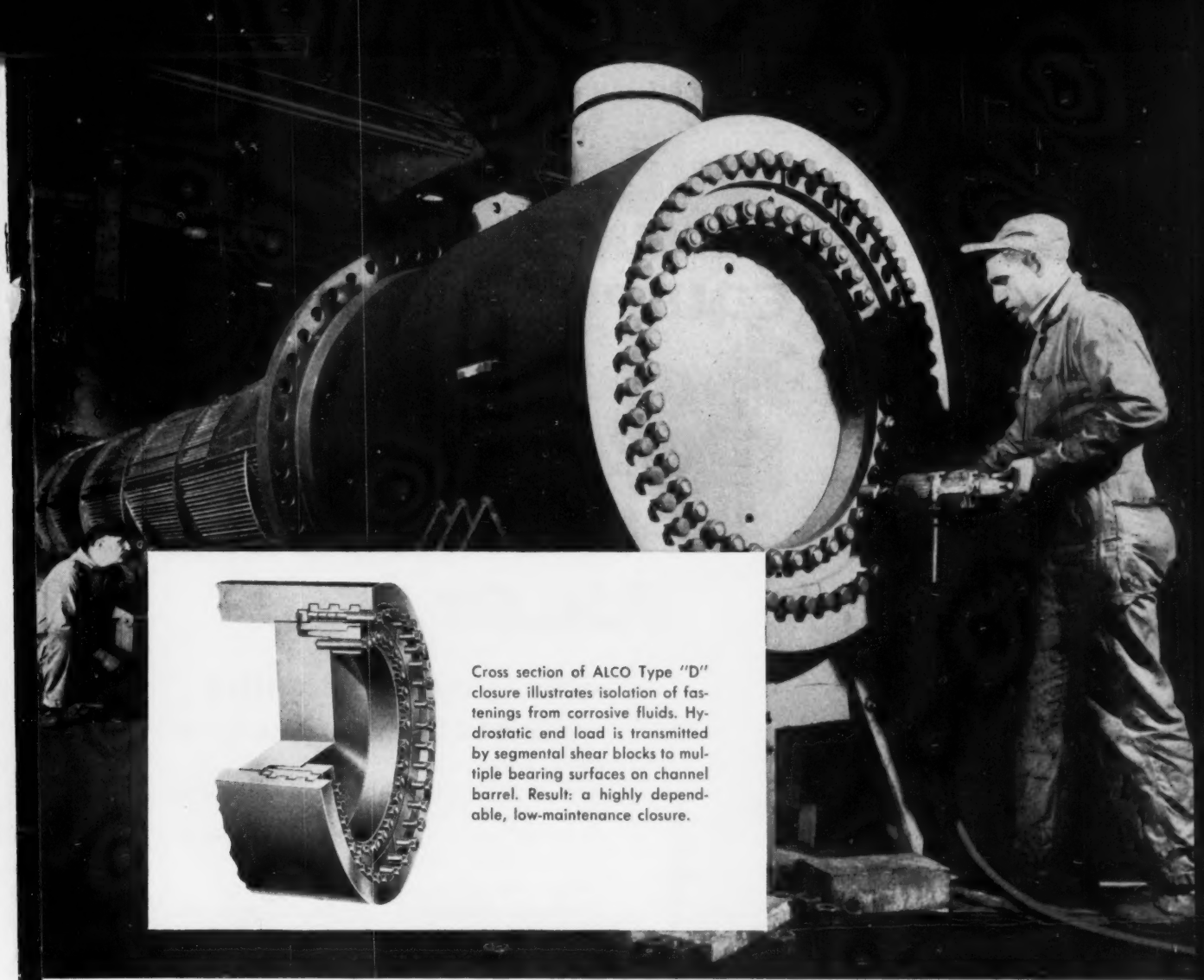

Cross section of ALCO Type "D" closure illustrates isolation of fastenings from corrosive fluids. Hydrostatic end load is transmitted by segmental shear blocks to multiple bearing surfaces on channel barrel. Result: a highly dependable, low-maintenance closure.

PROVED TYPE "D" CLOSURE PUTS EXTRA VALUE IN ALCO HIGH-PRESSURE FEEDWATER HEATERS

Mechanical locking arrangement makes tubes easily accessible without cutting or welding; closure can be easily dismounted and reassembled with hand tools

The ALCO-developed Type "D" high-pressure closure, standard on all ALCO high-pressure feedwater heaters, adds extra savings in operation and maintenance to these units. Its mechanical design permits access to the tubes without cutting open the closure and then doing expensive rewelding. Demounting and reassembly can be accomplished in a single shift—with significant savings in equipment down time.

The Type "D" closure is completely dependable. Extensive service in the country's largest steam-generating plants has proved its operation. Locking components and screwed fastenings are not contacted by the contained condensate, assuring easy disassembly of the cover. The screwed fastenings carry no hydrostatic end load so the gasket seal is not affected by fluctuating pressure.

It's another benefit of installing ALCO feedwater heaters in your plant. For years the toughest feedwater heating problems have been assigned to ALCO. Proof that ALCO has solved them is now in the country's largest high-temperature, high-pressure steam plants. ALCO evaporators, with their patented "Flextube" scale-shedding construction, are also proving their reliability and economy.

If you'd like more facts, we'll be happy to send you our Bulletins FH-2 and EV-1. They give complete details. Simply write Thermal Products Division, Dept. FHE-1, P.O. Box 1065, Schenectady 1, N. Y.

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NEW YORK

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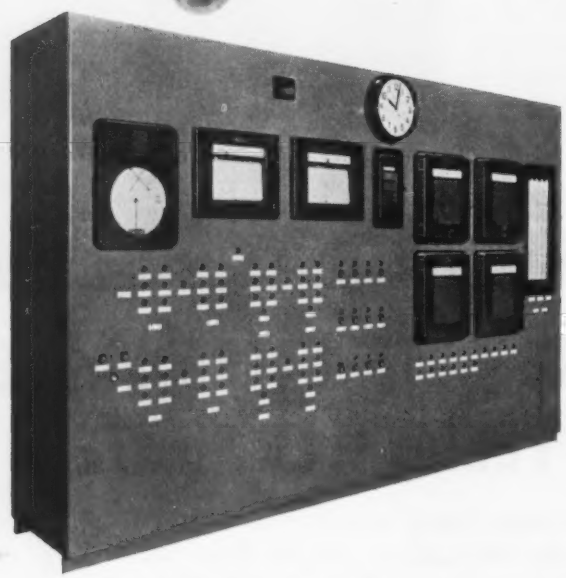
Locomotives • Diesel Engines • Nuclear Reactors • Heat Exchangers • Springs • Steel Pipe • Forgings • Weldments • Oil-Field Equipment

INFILCO DEMINERALIZATION EQUIPMENT...

ENGINEERED to meet YOUR requirements for HIGH PRESSURE BOILER FEED



Control Panel, Commonwealth Edison Company, Will County Station, Joliet, Ill.

- **Maximum reliability**
- **Highest quality water**

Check some of these installations. They are representative of INFILCO's advanced engineering and development in providing water suitable for today's (and tomorrow's!) high pressure steam generators in the utility field.

Alabama Power Company, Gorgas Station... Gorgas, Ala.
California Electric Company, Highgrove Plant... Highgrove, Calif.
Commonwealth Edison Company, Crawford Station... Chicago, Ill.
Commonwealth Edison Company, Will County Station... Joliet, Ill.
Commonwealth Edison Company, Station No. 6... Waukegan, Ill.
Chicago District Electric Generating Corp., State Line Station... Hammond, Ind.
Interstate Power Company, Dubuque Station... Dubuque, Iowa
Municipal Gas & Electric Department, Holyoke Plant... Holyoke, Mass.
Omaha Public Power District, North Omaha Station... Omaha, Neb.
Central Power & Light Co., Lon C. Hill Station... Corpus Christi, Texas
Central Power & Light Co., Victoria Station... Victoria, Texas
Wisconsin Power & Light Co., Rock River Station... N. Beloit, Wis.
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It will pay you to investigate. Write today for Bulletin 1960-C-PO-11.

Inquiries are invited on all water and waste treatment problems for all industrial purposes, including boiler feed water makeup, process water clarification and purification, sewage treatment, waste pollution control, material reclamation and related needs.

INFILCO

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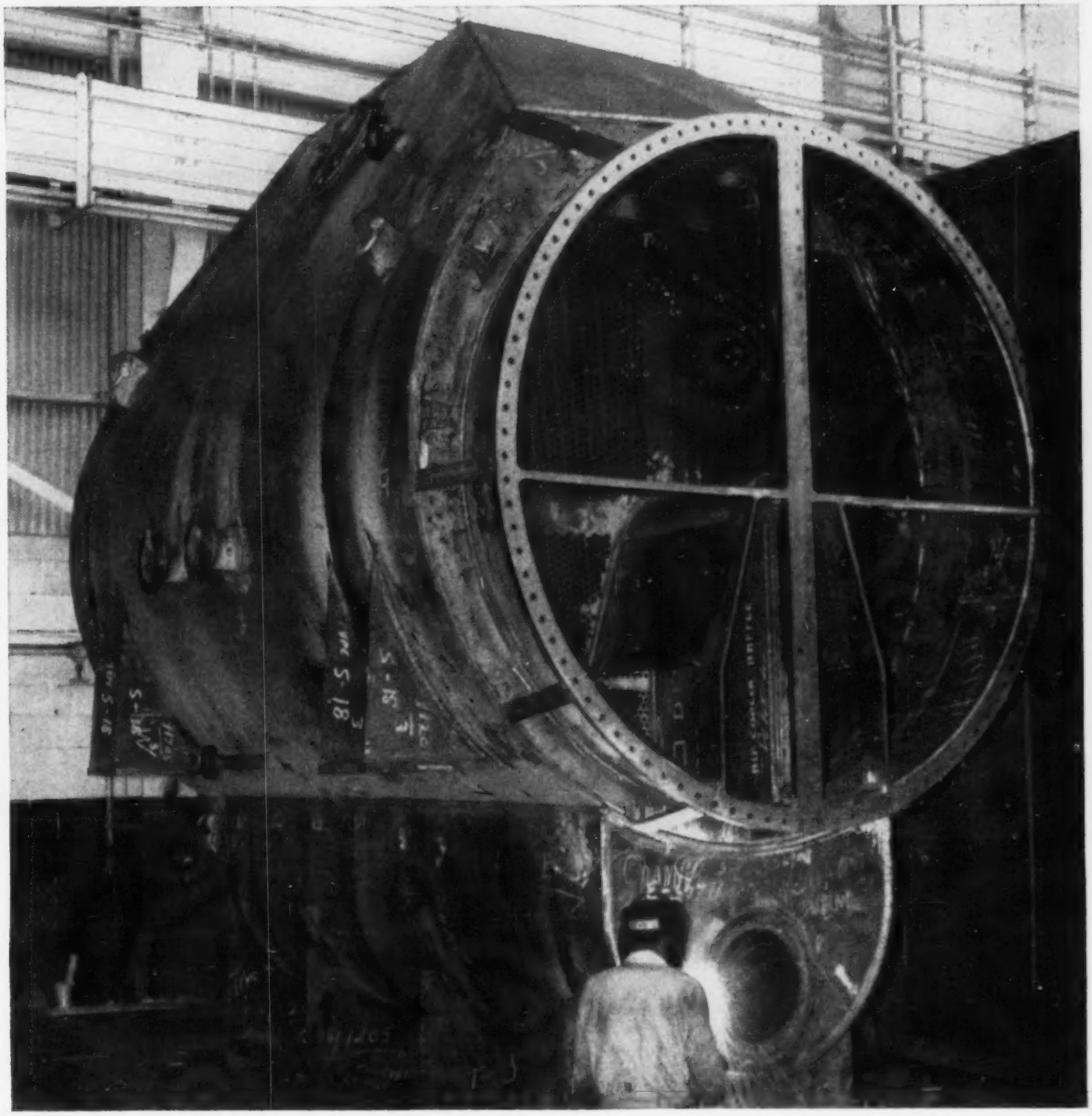
MARIND CONDENSERS

ECONOMY • RELIABILITY • PERFORMANCE



Thoroughly experienced design engineering and manufacturing staff. Every Marind job is backed by this Company's international reputation for outstanding quality, service, performance.

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POWER • INDUSTRIAL EQUIPMENT

Industrial Products Division

MARYLAND SHIPBUILDING & DRYDOCK COMPANY

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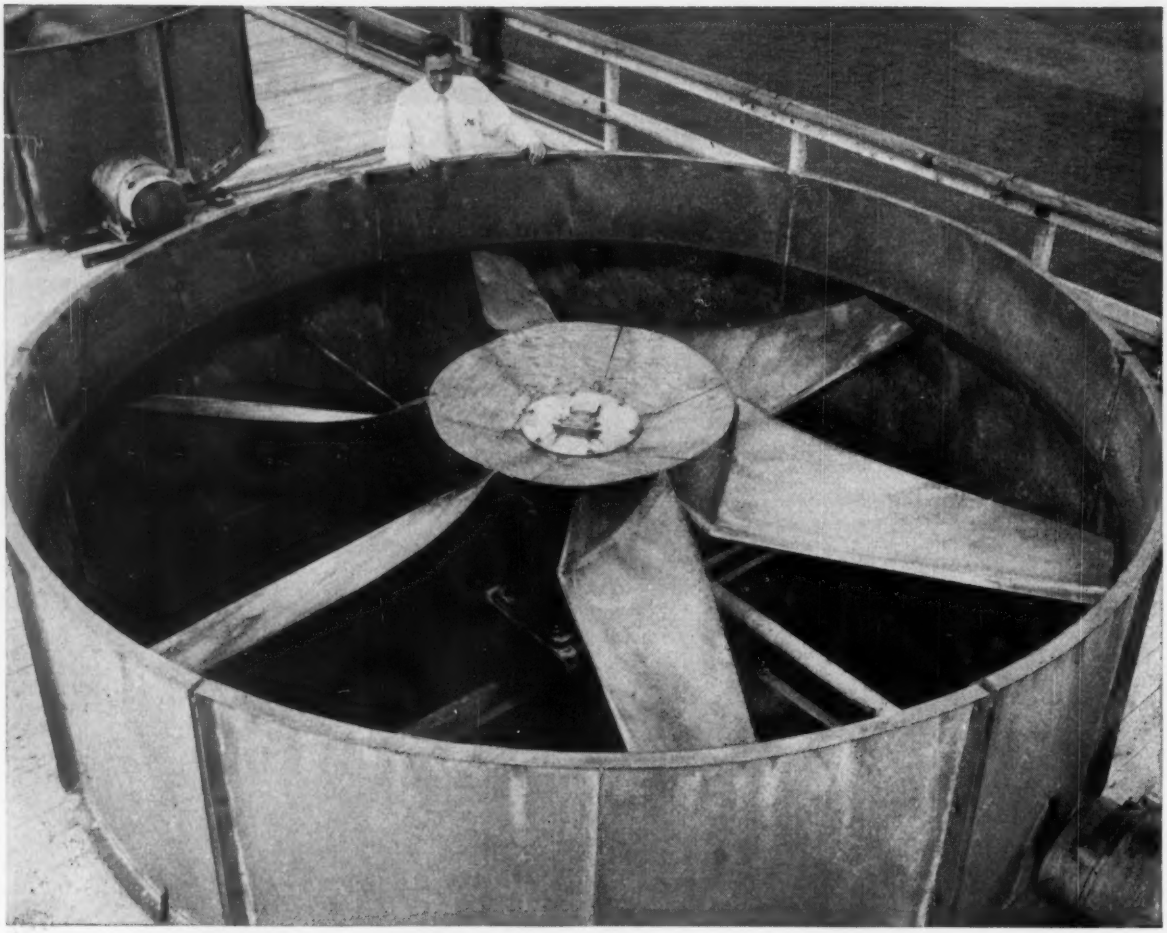


Inspecting Monel blades of 14-foot fan. *Sixteen such fans cool recirculated water for the 32,000 sq. ft. condenser in a 48,000 KW unit of Clark Station (Houston) at a rate of 37,500 G.P.M. After 850-million round trips through alkaline fog these . . .*

tireless Monel fan blades show no erosion and no corrosion

Cooling water for a unit of Houston Lighting & Power Co.'s Clarke Station is drawn from wells . . . recirculated through a condenser.

This water, must, itself be air cooled in a cooling tower. Sixteen, 14-foot diameter Class 7000 Moore fans suck the air through. With it ride millions of droplets of hot alkaline water.

Impact and corrosion from these tiny droplets attack the fan blades. What's more, the blades must absorb enormous numbers of slight flexures . . . and physical shocks caused by turbulence. Not many materials could take it.

But Monel* nickel-copper alloy does.

Look at the Monel alloy blades on the fan shown above! They've already lasted eight years. Made more than 850-million "round" trips without noticeable defect. So have the Monel blades on the other fifteen fans. And they seem to have years of service left.

The Moore Co., Marceline, Mo., says, "In cooling tower fan blades, Monel performs well consistently. And we find it easy to shape and weld."

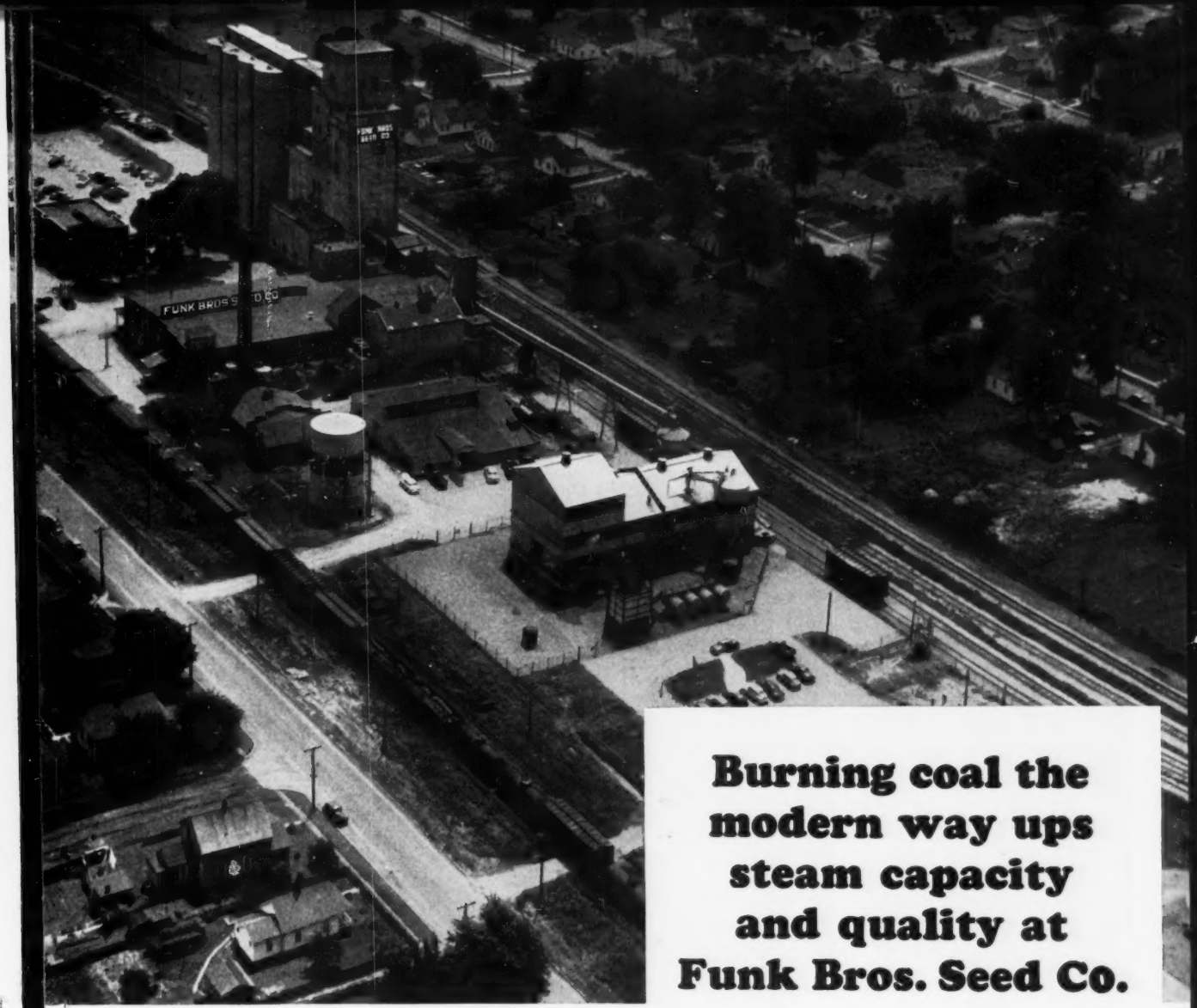
Maybe you should be using Monel for fan blades and other parts calling for good mechanical properties combined with high corrosion resistance. To look into it, simply contact Inco's Technical Service...an advisory group.

*Reg. Trademark of The International Nickel Company, Inc.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO Nickel Alloys

Monel... *for minimum maintenance*



Burning coal the modern way ups steam capacity and quality at Funk Bros. Seed Co.

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

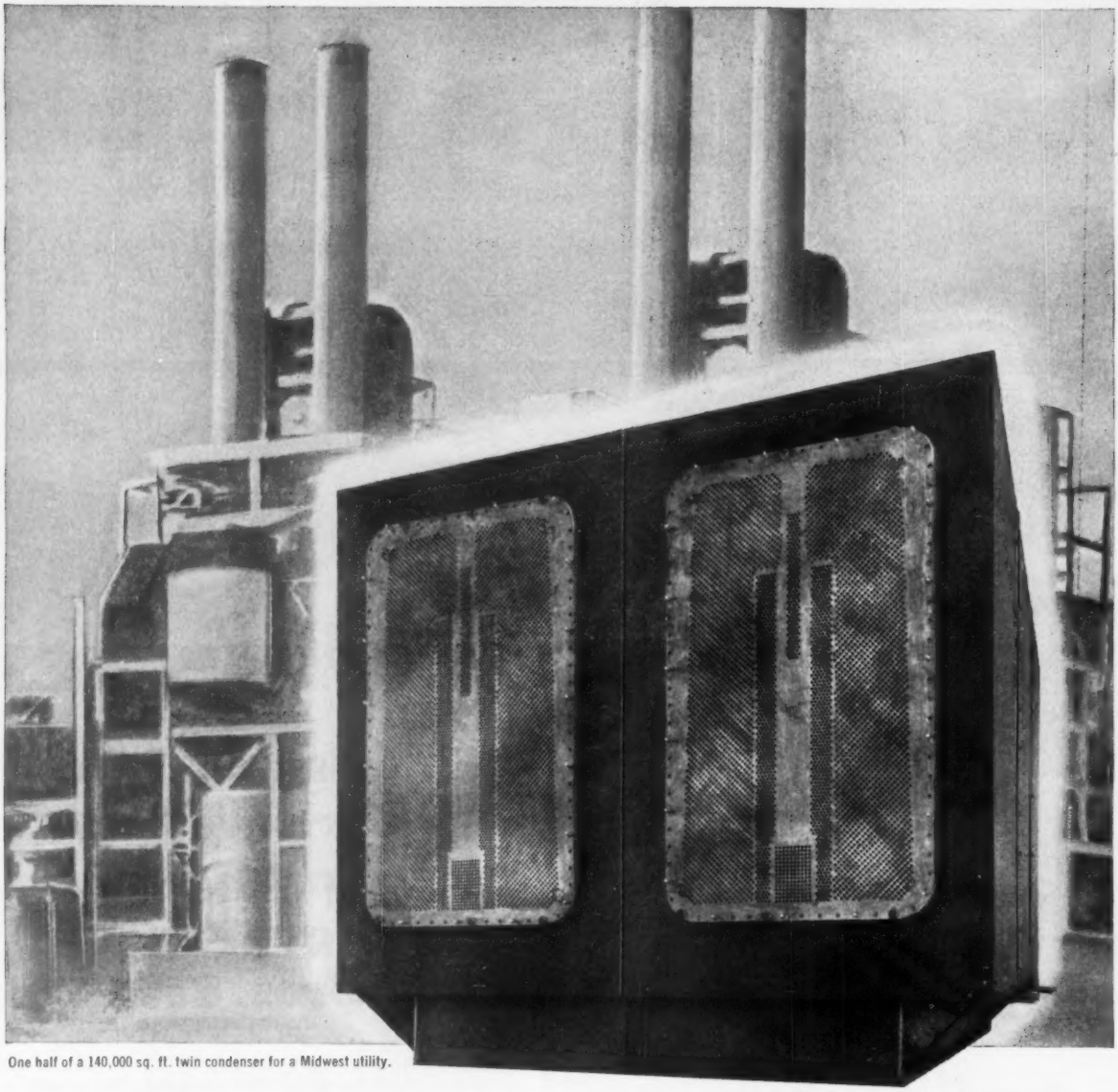
In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

As Funk Bros. Seed Co., Bloomington, Ill., increased the capacity of its soybean extraction plant 50%, the firm's old steam plant proved inadequate. Not only was it unable to produce enough steam, but steam quality was not suitable for best processing conditions. To remedy this situation, the company installed a new 26,000 lbs./hr. boiler, automatic controls, automatic coal and ash handling system and related equipment.

Today the steam plant at Funk Bros. requires only one man per shift, holding one of the most attractive operating jobs in the plant. Evaporation rates are in excess of 9 lbs. of steam per lb. of coal and there is adequate high quality steam for further expansion requirements. Also cleaner plant conditions resulting from this modernization have greatly improved community relations.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE
Southern Building • Washington 5, D. C.



One half of a 140,000 sq. ft. twin condenser for a Midwest utility.

C. H. WHEELER Principles of Steam Condenser Design Win Approval of Large Utilities

To help modern power plants conserve every BTU of boiler fuel C. H. Wheeler is working constantly to design and build more efficient steam condensers. Here are just a few of the more important features in C. H. Wheeler Dual Bank Condensers that are recognized by large utilities:

- *Deaeration . . . 0.01 cc per liter is attainable.*
- *"Zero" condensate temperature depression.*
- *Purity of condensate.*
- *Additional steam lanes shorten path and resistance to steam travel.*
- *Lower pressure drop and higher vacuum.*
- *Specifically designed for larger, more efficient electric generating stations.*
- *Adaptable to any station layout and designed to minimize field erection problems.*

C. H. Wheeler representatives are located in principal cities. Let us present a proposal for the most modern Steam Condenser, Pumps and Auxiliaries for your electric generating plants of tomorrow.

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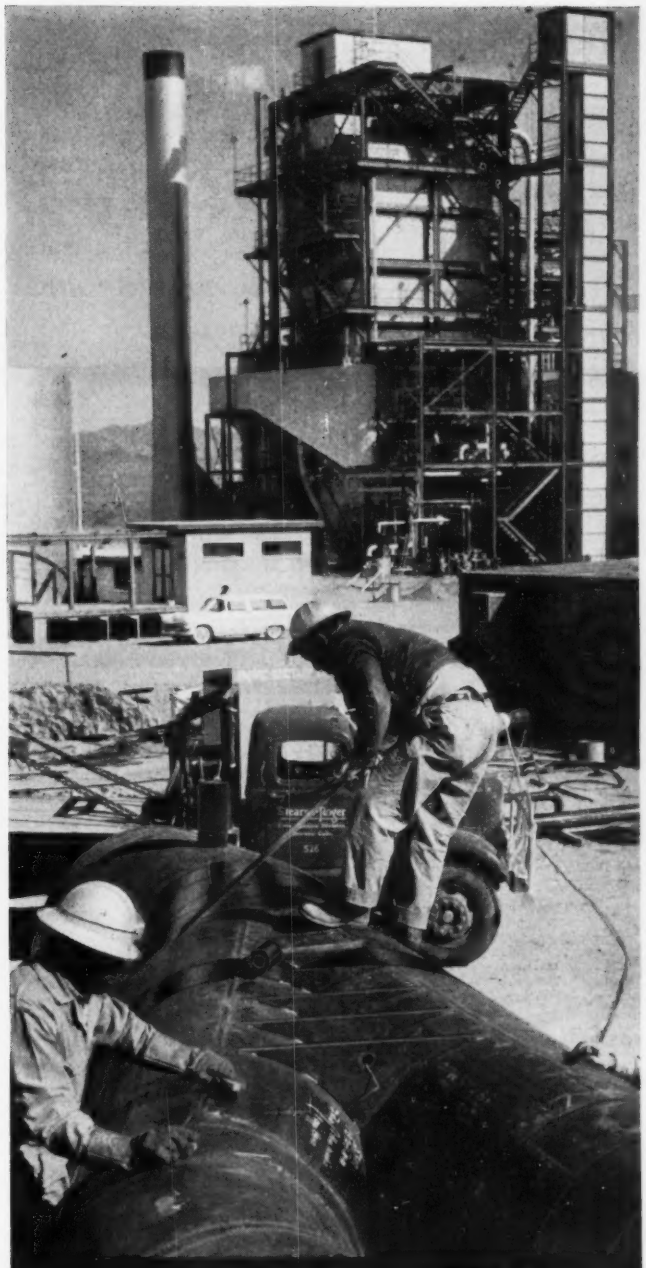

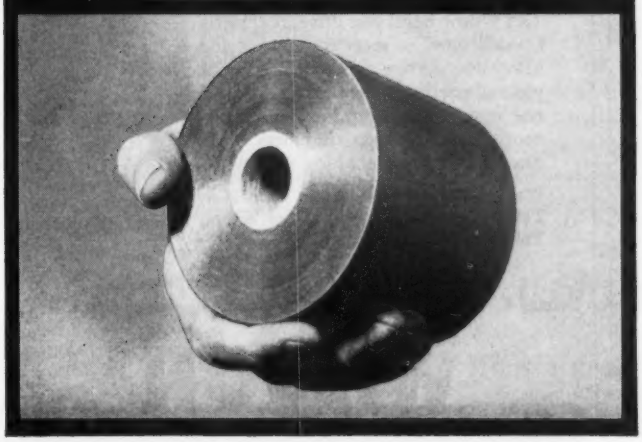

PRACTICAL PIPE PROTECTION

Practical protection for all pipe installations—and the only *practical* protection for some pipe coating jobs is "SCOTCHRAP."

That was the decision of the Stearns-Roger Co., Denver, when they had the job of coating these big pipes at a power station. Largest single pipes were 54 inches in diameter, tapering down to 36 inches. Stearns-Roger used "SCOTCHRAP" No. 51, 12 inches wide x 20 mils thick to wrap the pipes for complete protection.

Pressure-sensitive "SCOTCHRAP" is *polyvinyl chloride* plastic tape, tough enough to protect the biggest pipes; flexible enough to stand stress when pipe sags during final lifting into position. It can be applied on the job without heat and flame or special tools in absolute safety.

GET THE COMPLETE STORY. Send for free booklets describing protective qualities and easy application of "SCOTCHRAP." Just write on your letterhead to 3M Co., St. Paul 6, Minn., Dept. OO-37.

Quality pipe protection that rolls on dry...

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SCOTCHRAP BRAND PIPE INSULATION

The term "SCOTCHRAP" is a registered trademark of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn. Export Sales Office: 99 Park Avenue, New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

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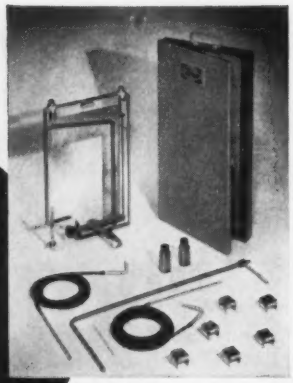

- Reads directly in feet per minute and inches of water.
- Check *all* velocities from 400 to 10,000 F.P.M.
- All static pressures from 0 to 10″ of water.

Tests fan and blower discharge and inlet pressures, pressure drop across filters, balances air conditioning systems, etc. Complete kit includes dual purpose manometer, 18″ stainless steel pitot tube, Magneclips and all necessary fittings, tubings, instructions and accessories.

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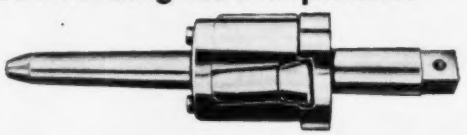
WILSON Maintenance Tools

Heavy-duty air driven tube cleaners

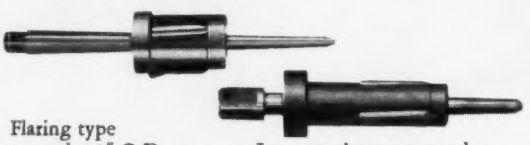
Designed to deliver maximum power at the most efficient cutter head speeds while negotiating sharp bends, the Model ECT Air Cleaners are excellent for cleaning curved boiler tubes from 2½″ to 4½″ O.D.

Self-feeding tube expanders



Wilson Model 38 tube expanders are self-feeding and parallel expanding. They are of the single flare roll type. Available for tubes 1″ O.D. to 4½″ O.D. with various roll lengths for tube seats ¾″ and up.

Model E Expanders



Flaring type expander 1″ O.D. to 4½″ O.D. tubes, ½″ to 2″ tube seats

Long reach type expander 1″ O.D. to 4½″ O.D. tubes, 2½″ to 5″ tube seats

Right angle bevel gear drive

This Wilson bevel gear drive is expressly manufactured to meet continuous and heavy duty service conditions. The one piece all steel body is extremely rigid and not subject to distortion. The maintenance of perfect gear alignment is assured with consequent long service life.

Write today for your copies of Wilson Tube Cleaner catalog No. 77 and Wilson Tube Expander catalog No. 88.

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Thomas C. Wilson, Inc. • 21-11 44th Ave., Long Island City 1, N. Y.
Cable address: "Tubeclean", New York

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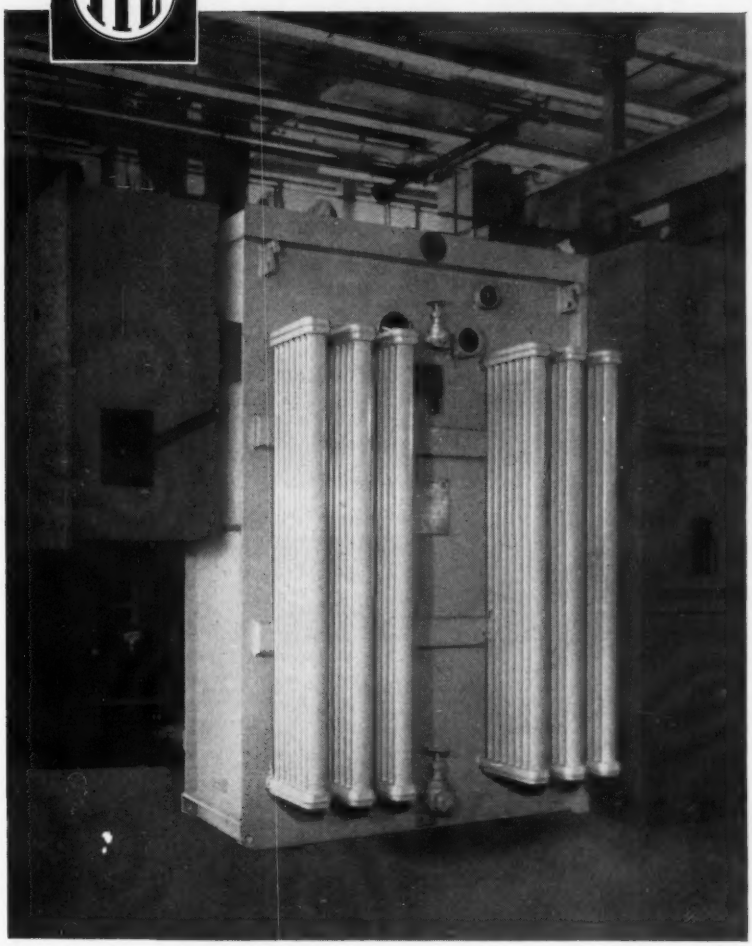
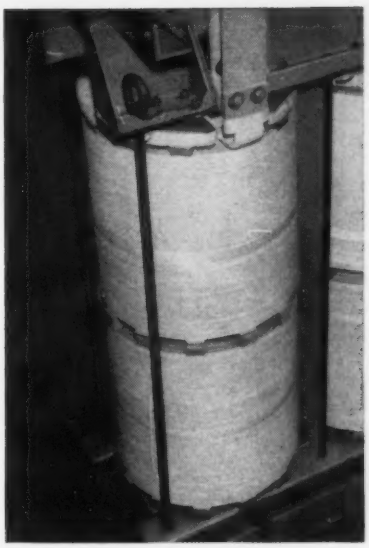
TUBE CLEANERS • TUBE EXPANDERS

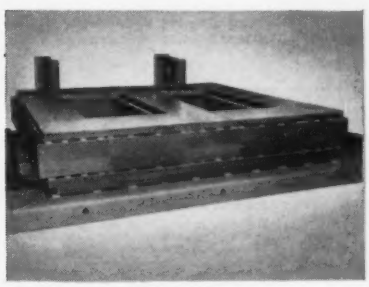
UNIT SUBSTATION TRANSFORMERS



No leakage here. Tanks on liquid-filled transformers are double welded—inside and out. Sides and cover are reinforced. Cover is gasketed and bolted in place.



Why coils stay put. Double jackscrews in combination with tie rods between upper and lower core clamps hold coils rigidly in place, even under severe stress.



Protection against noise. High-grade oriented silicon iron laminations are stacked flat on special tables. This keeps noise level low.

Resist heaviest stresses — even from frequent short circuits

Even if you don't anticipate frequent short circuits, you still benefit three ways from the extra strength and dependability built into I-T-E transformers:

1. *Less risk of trouble in service*
2. *Virtual freedom from transformer damage due to even abnormal stresses*
3. *Greater length of service*

I-T-E's ability to give you these important extra advantages comes from many years' experience building transformers for mechanical rectifiers and other special-purpose applications where direct short circuits are an ever-present possibility. Now the same construction is offered in transformers for substation use.

I-T-E transformers are available either ventilated dry type or immersed type and in a wide range of ratings. They are manufactured complete with all standard accessories and comply fully with all industry standards. The I-T-E factory is equipped to apply all NEMA tests. Write for complete information. I-T-E Circuit Breaker Company, Transformer & Rectifier Division, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

Transformer & Rectifier Division

7325-HC

Corrosion has an expensive appetite

Cleveland • Albany • Atlanta • Chicago • Davenport • Detroit • Houston • Los Angeles • Louisville • Lynchburg • Minneapolis • New York • Oklahoma City • Pittsburgh • Philadelphia • Salt Lake City • Seattle • St. Louis • Toronto, Canada

PROTECT YOUR INVESTMENT WITH A Harco CATHODIC PROTECTION SYSTEM

If you can afford the bill . . . enjoy your guest. But remember . . . you've got this guest whether you can afford her or not. Check your profits . . . and see what this appetite is costing you regularly.

Electrolytic corrosion is the biggest single destroyer of buried or submerged metal structures and pipelines.

IT CAN BE STOPPED. That's where HARCO comes into the picture. It's our business to protect your investment. We are the specialists who can prevent and cure electrolytic corrosion . . . QUICKLY AND ECONOMICALLY. It is a fact . . . most cathodic protection systems pay for themselves in a matter of months . . . just through savings in normal maintenance and replacement costs.

HARCO regularly supplies a complete range of services. Whatever your needs . . . engineered systems, contract installations or materials . . . LOOK TO HARCO . . . FIRST IN THE FIELD OF CATHODIC PROTECTION!

Write today for catalog or call MOntrose 2-2080

Harco

CATHODIC PROTECTION DIVISION
THE HARCO CORPORATION
17049 Broadway • Cleveland, Ohio

When it's B/M "Matched Metering"

—you know it's accurate!

The high fidelity of Burgess-Manning Electric and Electronic Meters is made possible only by the Burgess-Manning null-balance inductance bridge, servo-powered meter principle employed. To this has been added the refinement of a calibrated cam, which matches the calibration of the recorder-totalizer and the differential producer for perfection thru "Matched Metering." Burgess - Manning electric transmission is suitable for distances up to 5000 feet. You'll never regret having specified Burgess-Manning "Matched Metering" for greatest overall accuracy.

Burgess-Manning Meters are also available in mechanical types. Request Catalog 800

BURGESS-MANNING COMPANY
PENN INSTRUMENTS DIVISION
4114 Haverford Ave., Philadelphia 4, Pennsylvania

Instrumentation and Controls
for water, steam, gases, sewage and industrial wastes

Write for

Power's

REPRINT FOLDER

...SUMMARIES and PRICES

on **Power's** information-packed

SPECIAL REPORTS

"the most useful condensed handbooks in the power and plant service field."

BIG CITY • BIG DEMAND

BIG RIVER Solution: Big Pumps

Capacity 50,000,000 gallons a day

Installed for ST. LOUIS COUNTY WATER COMPANY, NORTH END PLANT, ST. LOUIS, MISSOURI

Intake Pumps: 4 - 150 hp Peerless 36" single-stage vertical turbine pumps.

Booster Pumps: 8 - 500 hp Peerless 22" single-stage horizontal double-suction pumps.

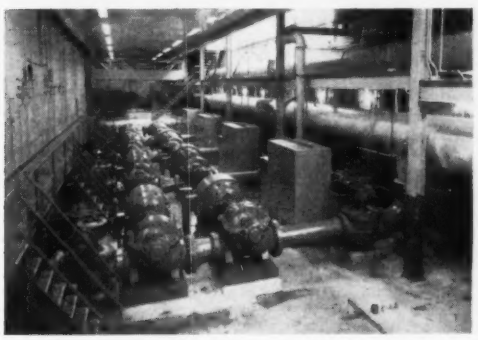
Here's another installation that convincingly demonstrates Peerless' ability to do the complete pumping job efficiently:

vertical pumps for **water supply**
horizontal pumps for **water pressure**

Either way you look at a pumping job—towards horizontals or towards verticals—follow the lead of consulting and water works engineers everywhere. Select Peerless horizontal and vertical pumps from one of the most complete lines of high quality, water handling pumps offered by any manufacturer.

Remember: Peerless builds dependable pumps for *all* water handling services—supplying, circulating, dewatering, drainage and flood control protection—and for all applications—municipal, industrial, commercial and domestic.

BIG VERTICALS—The middle 2 of these 36" single-stage Peerless vertical intake pumps are driven by 150 hp induction motors. The other 2 pumps (same specifications) are driven by wound rotor motors.



BIG HORIZONTALS—These 8 Peerless horizontal single-stage, double-suction pumps are driven by 500 hp motors. Mounted in series, these 22", high service pumps maintain pressure at required standard.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, Calif.

fmc

Factories: Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York; Atlanta; Chicago; St. Louis; Phoenix; San Francisco; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque.
Distributors in Principal Cities. Consult your Telephone Directory.

PLEASE SEND PUMP BULLETINS DESCRIBING

☐ Peerless Horizontal Pumps (Bulletin B-1300) ☐ Peerless Vertical Pumps (Bulletin B-505)

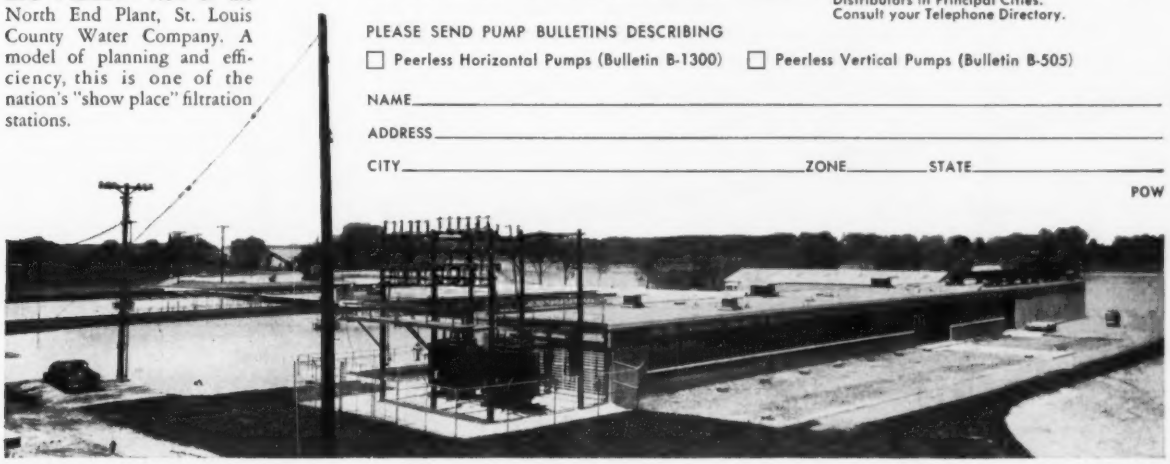
NAME_____

ADDRESS_____

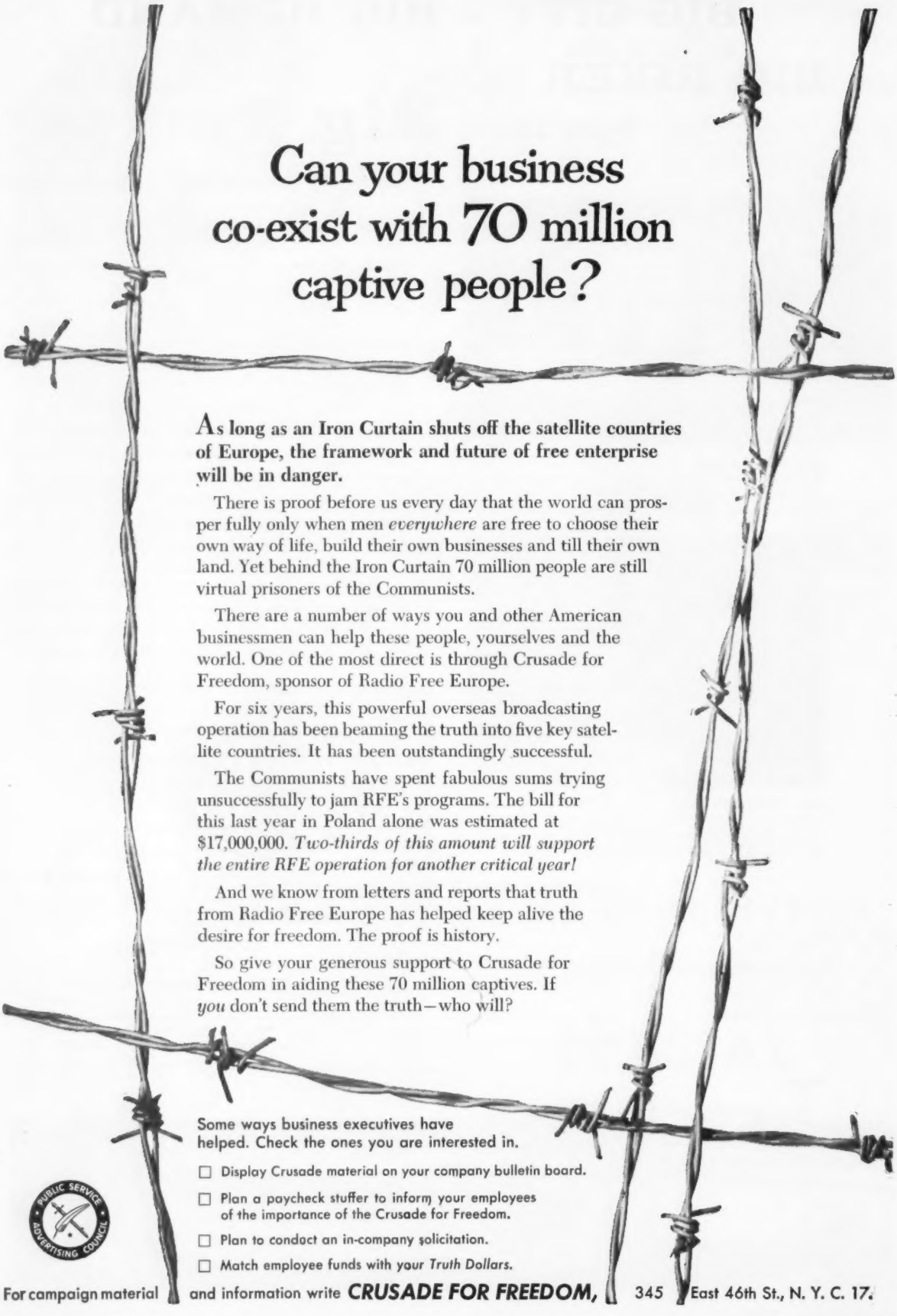
CITY_____ ZONE_____ STATE_____

POW

BIG PLANT—View of the North End Plant, St. Louis County Water Company. A model of planning and efficiency, this is one of the nation's "show place" filtration stations.



Can your business co-exist with 70 million captive people?



As long as an Iron Curtain shuts off the satellite countries of Europe, the framework and future of free enterprise will be in danger.

There is proof before us every day that the world can prosper fully only when men *everywhere* are free to choose their own way of life, build their own businesses and till their own land. Yet behind the Iron Curtain 70 million people are still virtual prisoners of the Communists.

There are a number of ways you and other American businessmen can help these people, yourselves and the world. One of the most direct is through Crusade for Freedom, sponsor of Radio Free Europe.

For six years, this powerful overseas broadcasting operation has been beaming the truth into five key satellite countries. It has been outstandingly successful.

The Communists have spent fabulous sums trying unsuccessfully to jam RFE's programs. The bill for this last year in Poland alone was estimated at $17,000,000. *Two-thirds of this amount will support the entire RFE operation for another critical year!*

And we know from letters and reports that truth from Radio Free Europe has helped keep alive the desire for freedom. The proof is history.

So give your generous support to Crusade for Freedom in aiding these 70 million captives. If *you* don't send them the truth—who will?

Some ways business executives have helped. Check the ones you are interested in.

- ☐ Display Crusade material on your company bulletin board.
- ☐ Plan a paycheck stuffer to inform your employees of the importance of the Crusade for Freedom.
- ☐ Plan to conduct an in-company solicitation.
- ☐ Match employee funds with your *Truth Dollars.*

PUBLIC SERVICE ADVERTISING COUNCIL

For campaign material and information write **CRUSADE FOR FREEDOM,** 345 East 46th St., N. Y. C. 17.

WHERE TO BUY

Featuring additional products specialties and services for power plants

TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers — the readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

POWER — Classified Advertising

STEEL PIPE & TUBING

• CHROME MOLY • CARBON MOLY
• CARBON STEEL • STAINLESS

Widest Range of Sizes & Specs in the U. S.
WRITE FOR STOCK LIST

MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

PROFESSIONAL SERVICES

CONSULTING DESIGN EXAMINATIONS PATENTS
CONSTRUCTION PLANS SURVEY • REPORTS TRADE MARKS

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction,
Investigations, Valuation and Rates
1500 Meadow Lane Pkwy, Kansas City 14, Missouri

THE LUMMUS COMPANY
Engineers and Constructors
385 Madison Ave., New York, N. Y.
Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

J. E. SIRRINE COMPANY
Engineers
Power Plant Consultations
Design Reports
Water Steam Utilization Plants
Greenville South Carolina

BURNS & McDONNELL
Engineers—Architects—Consultants
Kansas City, Mo. Phone
P. O. Box 7088 DElmar 3-4375

LUTZ AND MAY COMPANY
Consulting Engineers
Steam, Gas & Diesel Power Station
Pumping Plants—Electric Systems
Reports—Design—Appraisals
1009 Baltimore Kansas City 6, Mo.

STANLEY ENGINEERING COMPANY
Consulting Engineers
327 S. La Salle Street Hershey Building
Chicago 4, Illinois Muscatine, Iowa

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Design and Construction Supervision
Mechanical • Electrical • Structural
Sanitary • Chemical Laboratory
Business and Economic Research
New York Reading, Pa. Washington

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations
231 So. La Salle St. Chicago 4

SWANSON, WRIGHT & CO. ENGINEERS LTD.
Consulting Engineers
Industrial and Process
Forest Products Industries
Power Plants
Reports, Specifications, Designs, Supervision
2210 West 12th Ave., Vancouver 9, B.C. CEdar 1154

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

SANDERSON & PORTER ENGINEERS
Construction
Reports *Surveys*
New York New York

TIPPETT & GEE CONSULTING ENGINEERS
Mechanical—Electrical—Thermodynamic—Structural
Design—Studies—Supervision
Power Stations—Transmission—Distribution
Industrial Plants—Process
1333 North Second Street Abilene, Texas

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical
1200 N. Broad St. Philadelphia 21, Pa.

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

WATER SERVICE LABORATORIES, INC.
Specialists in Water Treatment for Corrosion Prevention
Main Office:
423 W. 126 St. New York 27, N. Y.

PETER F. LOFTUS CORPORATION
Design and Consulting Engineers
Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural
First National Bank Building
Pittsburgh 22, Pennsylvania

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Mechanical—Electrical—Civil
Surveys Reports Design
101 Park Avenue New York 17, N. Y.

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant | **Civil Service Opportunities** | **Employment Agencies**
Positions Wanted | **Selling Opportunities Wanted** | **Employment Services**
Part Time Work | **Selling Opportunities Offered** | **Labor Bureaus**

DISPLAYED ——**RATES**—— **UNDISPLAYED**

The advertising rate is $25.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

$1.65 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box Numbers—counts as 1 line

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS or Inquiries to Classified Adv. of Div. of Power, P. O. Box 12, New York 36, N. Y. for April issue closing March 8th.

Electrical Engineers Designers

BECHTEL

Offers you immediate long range engineering opportunity in

San Francisco
or
Los Angeles, Calif.

Engineers, designers and draftsmen required with the following experience:

Electrical Sub-Station
Hydro-Electric Power Plants
Steam Electric Generating Station

Liberal relocation allowances for you and your family.

Send Resume to
Manager of Employment & Placement
Industrial Relations Division

BECHTEL
CORPORATION
220 Bush Street
San Francisco 4, Calif.

For an immediate personal interview you may phone:
Paul Keating, MUrray Hill 7-7100, New York City
Joe Braddick, Fairfax 3-2401, Houston, Texas
Bill Milligan, Tucker 1549, Los Angeles, Calif.
Don Palmer, Douglas 2-4032, San Francisco, Calif.

MECHANICAL ENGINEER

Permanent position in long established central engineering department of one of country's fastest growing companies. Graduate, 5 to 10 years' experience industrial process engineer, full responsibility for project development, estimating, drawings and specifications, equipment ordering. No drafting. For more information write

Personnel Manager
AMERICAN-MARIETTA COMPANY
101 E. Ontario, Chicago 11, Illinois

THIS EMPLOYMENT OPPORTUNITIES SECTION offers a quick, effective solution to your manpower problems. Because its readership is confined to just the type of men you need, waste circulation is avoided.

REPLIES (Box No.): Address to office nearest you c/o this publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Designers—Electrical and Piping . . . Power Plants and Industrial Buildings. Marbarry Corp. 120 Greenwich St., New York City 6, N. Y. REctor 2-3749.

Relay Tester—Pasadena, Calif. Salary $441 to $537 depending on experience. Desired—2 years college; advanced courses in principles of electricity with 5 years experience in the installation, maintenance, and testing of power plant and sub-station instruments. Apply Rm. 200, City Hall.

Assistant Load Dispatcher — Pasadena, Calif. Salary $409-499. Six years experience desirable in the operation of power plants or major utility substations. Will assist in dispatching on a system consisting of 2 steam plants and related receiving & sub-stations. Apply Rm. 200, City Hall.

Hospital Engineer. Glens Falls Hospital, Glens Falls, New York, 50 miles north of Albany on Hudson River foothills of Adirondack Mountains. 300 bed hospital. Require technical education and several years experience chief engineer of hospital. Fine American community and good labor market. Excellent area to raise family and wonderful outdoor recreation summer and winter. Salary open; will depend upon experience. William G. Illinger, Superintendent.

SELLING OPPORTUNITIES OFFERED

Manufacturer's Representatives and Distributors —wanted to handle sales and service of miniature (¼ H.P. up to 5 H.P.) electric steam generators up to 100 lbs. pressure—each unit bearing a Registered National Board of Boiler and P. V. I. Number, individually inspected under the miniature boiler code. We have specialized in this field for 10 years and desire only men who know and work with steam, or equipment requiring steam for its operation. Please reply Box RW-3535, Power.

Water conditioning equipment manufacturer desires agents for New England and Upstate New York area. RW-3789, Power.

Agents Wanted: To represent prominent powerhouse chimney builder in Detroit, Louisville, Minneapolis, Kansas City and other large cities. Excellent adjunct for an existing boiler accessories representative. RW-4313, Power.

SELLING OPPORTUNITY WANTED

Sales engineer desires line of chemical solution proportioning pumps for metropolitan New York. SA-3510, Power.

POSITIONS WANTED

Institution Chief Engineer; Age 42, 12 years experience in all phases of Supervision, Maintenance and Operation of 2000 Bed Hospital. PW-4382, Power.

Division Superintendent in diesel-hydro system, now employed abroad, available Aug. 1st. ICS diploma in electrical engineering; age 39. Prefer eastern U.S. PW-4346, Power.

Personnel Managers—Need experienced Engineers and Technicians? We offer a booklet especially prepared to help you solve this problem. Write for your "free" copy of "Reservoir of Engineers and Technical Men." P. O. Box 12, New York 36, N. Y.

BOWATERS SOUTHERN PAPER CORPORATION
and
BOWATERS RESEARCH AND DEVELOPMENT INCORPORATED

South's largest and newest newsprint and pulp mills has the following permanent position available:

POWER PLANT ENGINEER

Located in Eastern Tennessee Valley. Excellent recreational, residential facilities. Exceedingly favorable year around climate, near Chattanooga and Knoxville, Tennessee. Complete insurance, retirement, salary and vacation programs. All applications treated in confidence. Reply immediately submitting summary of experience to:

BOWATERS SOUTHERN PAPER CORPORATION
Industrial Relations Department
CALHOUN, TENNESSEE

PERSONNEL MANAGERS

NEED ENGINEERS . . . TECHNICIANS?

Write us today for a free copy of

"RESERVOIR OF ENGINEERS & TECHNICAL MEN"

It explains how you can pin point your employment advertisement to just those men with the job qualifications you want . . . without wasting money on superfluous circulation.

Classified Advertising Division
McGraw-Hill Publishing Company, Inc.
Box 12, New York 36, N. Y.

DESIGNERS

4 MAJOR JOB ADVANTAGES

now offered by
DU PONT

•

Interesting, challenging, professional work assignments.

•

Long-range company programs assuring stability.

•

Promotion-from-within policy assuring opportunities for advancement.

•

Varied technical and administrative training programs.

•

IMMEDIATE OPENINGS FOR:

Power Designers
Heating & Ventilating Designers

Apply today for a position that will allow you to realize your full potential as a designer. Your work will be in a wide range of increasingly important fields.

Please send complete resume, including details of education and experience, to:

Mr. T. J. Donovan
Engineering Department

DU PONT

Better Things for Better Living
...through Chemistry

E. I. du Pont de Nemours & Co., Inc.
Wilmington 98, Delaware

MECHANICAL ENGINEER

Large engineering and construction firm located in New York has staff position open for a Mechanical Engineer with experience in steam electric station operation to engage in plant betterment work which involves assistance in starting new units, testing, advising and consulting in respect to operating problems, improving steam plant efficiencies, advising in respect to procedures and maintenance practices, and related problems. Reasonable knowledge of water treatment problems, practices etc. desirable.

Substantial travel involved. Salary commensurate with experience. Attractive company benefits. Give full particulars, age, education, experience in detail, and salary expected.

Send complete resume to Dept. B

P-4308, POWER
Class. Adv. Div., P.O. Box 12, NY 36, NY

MECHANICAL or ELECTRICAL ENGINEER

Excellent opportunity for a graduate engineer with at least five years power experience on coal fired boilers. Assignment will involve design, testing, and operation. Prefer man with public utility experience who is capable of planning renovation and expansion of boiler and turbine rooms. The position is with The B. F. Goodrich Company in its Akron, Ohio operations. Liberal employee benefit programs; moving allowance.

Write in strictest confidence, outlining personal history, work experience and present salary.

Mr. W. R. Bond
Employment Manager
THE B. F. GOODRICH CO.
Akron, Ohio

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED —RATES— ***DISPLAYED***

(Not Available for Equipment Advertising)

$1.65 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box Numbers count as one line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

The advertising rate is $17.90 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on one column, 3 columns, 30 inches to a page.

Send new ads or inquiries to Class Adv Div. of POWER, P. O. Box 12, N Y 36, N Y April closes Mar 8th.

WANTED

Steam Engine Generator Sets • Turbines • Condensers • Generators • Boilers or Complete Power plants.

PAUL OBERMAN
1910 Delmar **St. Louis, Mo.**

WANTED

SILICIUM POWER RECTIFIERS FOR EXPORT

We are looking for a contact with a manufacturer of Silicium diodes or complete rectifier sets.

W4215, POWER
Class. Adv. Div., P.O. Box 12, N. Y. 36, N. Y.

WANTED

OLD "TIRRILL" REGULATORS

Three Identical General Electric or Westinghouse Voltage Regulators are Needed for 60 Cycle Generators. Eight or More Relays. 50-125 Volts D.C.

W-4128, POWER
520 N. Michigan Ave., Chicago 11, Ill.

WANTED—MACHINE TOOLS

5 ft Radial Drill—used preferred
20" by 10' or 12' lathe—used preferred. Lathe approx 28" x 10 or 12 ft must have 9" hollow spindle—New or excellent condition.

SOUL CLINIC INC., CALGARY, CANADA

2600 KW DIESEL POWER PLANT

Four each General Motors 12-567A Diesels, 1080 BHP, 720 RPM direct connected to 937.5 KVA, 659 KW Electric Machinery Manufacturing Company alternating current generators, 3 phase, 60 cycle, 480 volts.

These units being offered complete with all control and auxiliary equipment. Now in operation and may be inspected at any time. Will be available in April. Will sell separately.
BIDS INVITED

WAH CHANG MINING CORP.
137 Clarke St., Bishop, Calif. Ph. 8911

HYDRO ELECTRIC GENERATING UNIT

Vertical type—585 HP—36 Ft. Hd.—150 CSF. Westinghouse Generator—500 KVA—2300 Volt—Direct Connected Exciter—Woodward Governor—Complete Switchboard—Leffel-F-Turbine. Location—Washington D.C. Reasonably Priced.

SORENSEN GOVERNOR SERVICE
264 Kossuth St, Bridgeport 8, Conn.

FOR SALE

1 STRONG-SCOTT PULVERIZER

Size B12-LH, equipped with a B8 blower. Serial #51123, S.O. 613036 with extra parts.

GLOVERSVILLE KNITTING CO.
Gloversville, New York

(Additional Wanted Advertising on page 296)

GUARANTEED REBUILT POWER EQUIPMENT

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2000	*G.E.	MT	257
1500	*Westg.	CW	600
1200	*Al.-Ch.	ANT	1800
600	*G.E.	MT	450
500	Westg.	CW	600
300	G.E.	IM-17B	600
250	*G.E.	IM	720
200	G.E.	IM	600
200	Westg. (2)	CW	514
200	*Westg.	CW-905A	514
150	Cr.-Wh.	50-R	1800
150	Westg.	CW	450
125	G.E. (2)	IM-15A	600
100	G.E.	IM-13A	1800
100	G.E.	MTC-5546	900
100	G.E.	IM	720
100	G.E.	IM	600
100	G.E.	IM-15A	450
75	G.E.	MT-347	1200
75	G.E.	IM	1200
75	Al.-Ch.	ARY-223C	1200
75	G.E.	MT-356	900
75	Al.-Ch.	ANY-28F	900
75	Al.-Ch.	ARY	720
75	G.E.	MT-352	720
75	G.E.	MT-556	720
75	G.E.	IM	600
60	Al.-Ch.	ARY	1200
60	G.E.	MT-546	1200
60	*G.E.	MT-536	1200
60	*Westg.	CW762C	900
60	Westg.	CW	1800
50	G.E.	IM-11A	1800
50	*Al.-Ch.	ARY	1200
50	Westg.	CW636A	1200
50	*G.E.	MT-536	1200

SLIP RING MOTORS

Crane & Hoist Service

3 phase, 60 cycle, 220 or 440 volts

H.P.	MAKE	TYPE	SPEED
80	G.E.	MTC-5552	600
75	Westg.	CI-756A	600
50	Westg.	MW-334	600
50	G.E.	HIC-TENV	600
35	G.E.	MTCV-5536	600
20	Westg.	CI	1200
11	Westg.	CI-E464	600
10	P & H	BW-6	1800
5	P & H	BW-6	1200
5	N. West.	WRC	1200
3	G.E.	MTC-5044	900

DYNAMOMETERS

250 VOLT DC WITH PANELS AND GRID RESISTORS

H.P.	MAKE	TYPE	SPEED
125	G.E. Cradle	TLC-20	2700/8000
150(3)	G.E. Cradle	TLC-50	2500/5000
200	Westg.-Block	SK-151	1350/4000

PLATERS

AMPS.	MAKE	VOLTS
7500/3750	Elec. Prod.	6/12—220/440
2000/1000	Chandy.	6/12—220/440
1500/750	Chandy.	12/24—220/440
1500/750	Chandy.	6/12—220/440
1000/500	Chandy.	12/24—220/440

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1250	*Al-Ch. (3)	ANX	3600
1200	*Al-Ch.	ARW	1200
750	*Westg.	CS	900
500	*Al-Ch.	ARW	3600
500	*G.E.	KT569S	900
500	G.E.	KT-424	450
350	*G.E.	KT-559A	1800
250	Westg.	CS-8120S TEFC	1800
250	G.E. (2)	KT-559	1800
250	*L-Allis	OEX-148	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600
250	Westg.	CS-14	514
200	*G.E.	FT-549Y	3600
200	*G.E.	IK-13B	1800
200	G.E.	KT-564	900
200	*Westg.	CS-930A	900
200	G.E. (2)	KR-564S	720
200	Al-Ch.	ARWWT	600
150	G.E.	IE-13B	1200
150	*Al-Ch.	AN-30F	1200
150	G.E.	IK-15A	900
150	*Westg.	CS	600
125	Westg.	CS-771 Sppf	1800
125	*Al-Ch.	AR	1800
125	Westg. (2)	CS-761S	1750
125	Cr. Wh. (2)	Size 5QR	1200
125	*Reliance	AA 6085	900
125	Al. Chal.	AN	514
100	Westg.	CS5075 TEFC	3600
100	*Westg.	CS-760A	1800
100	*G.E.	FT-542Z	1800
100	G.E.	FTRP-543	1800
100	*Westg.	CS-760D	1200
100	G.E.	KT-583	1200

D. C. MOTORS

H.P.	MAKE	TYPE	SPEED
250	Westg.	SK-220	450/800
200	Reliance (2)	1400T	350/1200
200	Westg.	SK-201	650
200	Cr. Wh.	CM	500
175	G.E.	ELC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
100/150	G.E.	MCF	380/1000
50	Cr. Wh.	CMC	700/1100
35	Westg. (2)	SK150	350/1000
30	Cr. Wh.	CCM-504	450
30/40	G.E. (2)	CD-123	400/1600
30/40	G.E.	CD-115	500/1500
25/30	G.E. (2)	RF-12	500/1800
25	G.E.	RC-32	800
25	Westg.	SK-133	575
20/25	Westg.	SK-151L	250/1000

M.G. SETS

K.W.	MAKE	A.C.	D.C.
1250	Westg.	6600/4160	600
1000	G.E.	12000	600
500	Westg.	2300	125/250
400	A.C.	2300	120/240
300	Westg.	2300/440	250
200	G.E.	2300	250/275
200	Westg.	2300/4000	250/275
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	A.C.	2300	275
150	Westg.	2300	125/2
150	G.E	440	275
125	Cr. Wh. (3)	4160	125
100	G.E.	2300	250
100	Al-Ch.	2300	250
100	Elec. Mch.	440	125

CHICAGO *Electric Co.* 1320 WEST CERMAK RD., CHICAGO 8, ILL.

STEAM GENERATORS

CAPACITY EACH — 60,000 LBS. STEAM PER HOUR

Manufactured by Foster Wheeler for the U. S. Navy. Two of these powered a Destroyer Escort Vessel. They can be outfitted for seagoing vessels; or are adaptable for industrial use where high temperatures and pressure are required.

New, never used, never erected. Stored indoors. 2 drum, 435 psi operating pressure, 740 deg. F. final steam temp., with superheater, economizer, fuel oil burners, soot blowers, valves and fittings. All accessories by well known manufacturers.

A tremendous buy over new manufacturers prices. Located at Utica, New York. Inspection and inquiries invited.

PELNIK-LOCONTI INDUSTRIAL SUPPLY CO.

Office Ph. Utica 6-4621 — Yard Ph. Utica 2-4513

315 Oriskany Street, Yorkville, N.Y.

DIESEL GENERATOR SETS

2—McIntosh-Seymour (Alco) 950 HP 8 cyl. 225 RPM, 875 KVA Westinghouse 3 phase, 25 or 60 cycle alternators. 20 KW exciters.

1—McIntosh-Seymour (Alco) 600 HP 5 cyl. 225 RPM, 500 KVA General Electric 3 phase, 25 or 60 cycle alternator. 15 KW exciter.

Complete plant installation with all accessories. Priced attractively. With or without generators.

MISSISSIPPI VALLEY EQUIPMENT CO.

611 Olive St. • St. Louis 1, Mo.

FOR SALE — USED HYDRO ELECTRIC UNITS 3 PHASE, 60 CYCLE

Setting	Connection	Head	RPM	H.P.	Gen.	KVA	Voltage	Exciter
PAIR HORIZ.	DIRECT	38	600	250	G.E.	225	2300	DIR. CONNECT
VERTICAL	DIRECT	36	300	585	WEST.	500	2300	D.C.
VERTICAL	DIRECT	17	300	340	WEST.	312	550	D.C.
VERTICAL	DIRECT	22	327	390	G.E.	312	550	D.C.
VERTICAL	DIRECT	11.5	120	225	G.E.	180	2300	M.G. SET
SINGLE HORIZ.	V-BELTED	21	900	95	EL. MACHY.	125	220	V-BELTED

Above Units complete with Oil Pressure Governors and Switchboards. Conditions of sale supplied upon request. Similar and related used equipment available. Let us know your requirements.

DEXTER HYDRO-ELECTRIC CORP.

BOX 15, DEXTER, N. Y.

COMPRESSOR DIRECTORY

World's Best Rebuilts

90 CFM	1500 PSI	8½-9⅞x1⅝x7 Chicago TCB3
138 CFM	100 PSI	7x7 Ingersoll ESI
234 CFM	100 PSI	9x9x9 Chicago (Steam) New
288 CFM	500 PSI	10-4½x10 Ingersoll XOB
284 CFM	100 PSI	Chic. PE 50 HP
437 CFM	40 PSI	12x9 Ing ESI (New)
440 CFM	50 PSI	13x10 Worth—oil-less
552 CFM	100 PSI	13-8"x12 Ingersoll XRB
502 CFM	125 PSI	12x13 Chic T
676 CFM	100 PSI	15-9½x12 Worth
593 CFM	100 PSI	13½-8x8 IR-XRE
868 CFM	100 PSI	17—10x12 CP-OCE
1600 CFM	40 PSI	Fuller Rotary—Syn.
1723 CFM	110 PSI	140 lbs. at Ingersoll XPV
50—800 CFM	Portables—Rotary or Reciprocating	

American
AIR COMPRESSOR CORP.
DELL AVE. & 47th ST
NORTH BERGEN, N.J.
Telephone UNion 5-4848

AIR COMPRESSOR

Ing.-Rand 14½" x 14½" x 10", Type XRE, low press. 35#, 1370 CFM, 1 stage, 360 RPM, W/150 H.P. Whse. sync. motor 3 ph., 440 V., shaft mounted, new 1952, fully complete.

Further inf. upon request.

PHILADELPHIA TRANSFORMER CO.

Box 566 • Dalton, Pa.

NEW AIR EJECTORS

Either C. H. Wheeler or Westinghouse. Type 4H55. Capacity 12 lbs. air/hr. Operating steam pressure 275 lbs. gauge.

NEW SURPLUS M.G. SETS

(2) 4-bearing ball-bearing self-ventilated drip-proof. MOTORS: 180 HP—440/3/60—226 amps—1200 RPM—synchronous. GENERATORS: 125 KW—120 volts—1070 amps—type CD—size 52H—42°C rise. Drip-proof enclosed marine units. Mfg. by Crocker-Wheeler. All set on common base.

SUBMARINE MOTOR

(1) G.E.—1375 HP at 415 volts DC—2-bearing ball-bearing—1375 RPM.

THE BOSTON METALS CO.

313 E. BALTIMORE STREET

Baltimore 2, Md.—Lexington 9-1900

B & W BOILER

66500#-Hr., 650#, 750°F. 4-DRUM STERLING TYPE. Complete in all Respects.

CHARLES WEAVER, M.E.

19701 JAMES COUZENS HIGHWAY

DETROIT 35, MICHIGAN

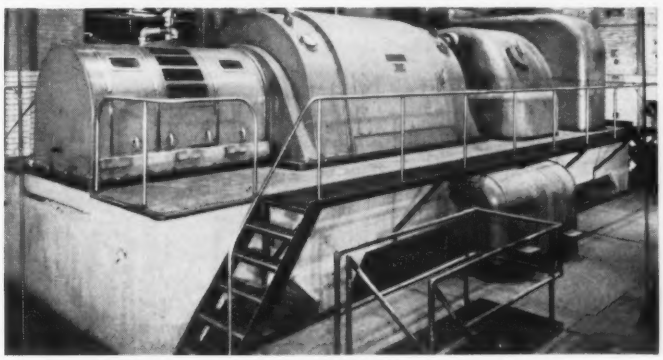
BULLETIN 9850

SPECIAL OFFERING

Just Released from Service, Immediately Available

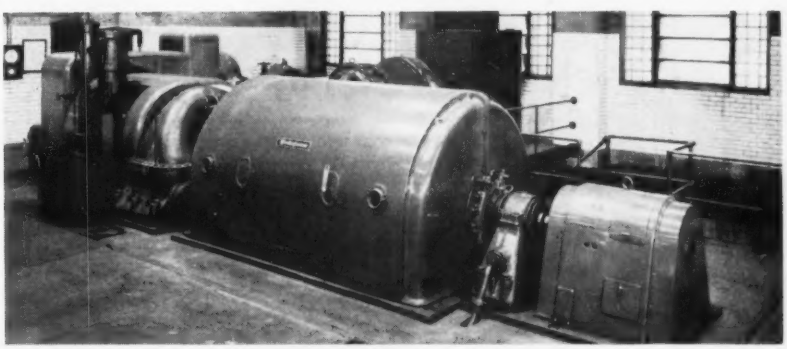
2—650 LB. PRESSURE, 750° FTT TURBINE-GENERATORS

10,000 KW, 70% P.F., 14,286 KVA below:



This 10,000 KW is a Westinghouse, Condensing 650 Lb. PSIG, 750° FTT Turbine. It is equipped with Surface Condenser, Switchboard, with all auxiliaries, direct connected Exciter (closed type). Generator is 3/60/13,200 V., 3600 RPM at 70% P.F., 14,286 KVA. Installed new in 1947.

The 5000 KW, 650 Lb. PSIG, described below, was operated same plant as 10,000 KW:



The above 5000 KW Condensing Westinghouse unit, 650 Lb., 750° FTT is in the same plant as the above 10,000 KW Turbine and is an Automatic Extraction unit 30#, 35,000#/hr. Generator is 3/60/13,200 V., 3600 RPM, 70% P.F., develops 7142 KVA. It is also equipped with Surface Condenser, Switchboard, closed type directly connected Exciter, and is complete with all operating auxiliaries.

Both machines can be inspected on original foundations, in operation. Investigate while available.

CHARLES WEAVER

19701 James Couzens Hwy. **Detroit 35, Michigan**

Phone: Broadway 3-1901

BELYEA RE-NU-BILT

LARGE ELEC. POWER EQUIPMENT
SELECTED STOCK ITEMS

RE-NU-BILT—GUARANTEED—RE-NU-BILT
COMBINATION MILL DRIVES — 15/2500 HP
D.C. MOTORS WITH M.G. SETS & CONTROLS

Qu.		MAKE	TYPE	VOLTS	R.P.M.
1—2200	HP	G.E.	MCF-12	600	400/500
22001	KW	G.E.	Syn	2300/4600	514
1—1250	HP	G.E.	MCF	600	600/750
1000	KW	G.E.	Syn.	2300/4600	720
1—1000	HP	G.E.	MCF-8	600	350/700
1000	KW	G.E.	Syn.	2300/4160	720
1— 225		Whse.	SK-185	575	950/1200
1— 300	KW	Whse.	Sq. Cage	440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
2	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT	6600	257
1	1500	G.E.	MT	6900	1187
1	1100	F.M.BB	SF8088	4800/2400	1800
1	1000	A.C.	Mill	2300	240
1	800	G.E.	MT	2300	293
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	400	Whse.	CW	440	514
1	350	Cr. Wh.	SIZE-290	2300	350
1	350	G.E.	IM-17A	440/2200	720
1	250	G.E.	MT-424Y	4000	257
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
1	200	G.E.	MT-557Y	220	1760
1	150	Whse.	CW30E17	2300	435
1	125	A.C.	ANY	440	865

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
1	650	G.E.	FT-559BT	440	3570
3	450	Whse.	CS-1420	2300/4150	854
1	400	G.E.	1K	2300	500
1	300	G.E.	KT-559A	2300	1775
1	200	G.E.	1K-17	440	580
3	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4850	C.W.	3501-SL	13800/6900	514
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900
3	2000	Whse.		2300	120
1	1100	G.E.	ATI	2300/4600	900
3	850	G.E.	TS	2200	150

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2300/4600
1	2000	G.E.	500-25cg	650	11000
2	2000	G.E.	514	600	4600/2300
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	514	250	2300/4600
1	1000	G.E.	900	260	6600
3	1000	G.E.	720	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
3	300	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300

WELDING M.G. SET

Gen. Elec.—1100 Kva 0.7 p.f.—2300/4600 V. 3/60 Generator with 1750 Kva—.8 p.f.—2300 V. 3/60 motor complete with exciter set and controls.

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltage
1	3000	A. C.	OISC	3	33000x2400/4160
1	2500	Al. Ch.	OISC	3	34500x13800
3	1000	G.E.	OISC	1	13800x230/460
2	750	G.E.	Fur	1	4800x85/55
3	500	G.E.	HD	1	4800/2400/480
3	500	Kuhl	OISC	1	13800x2040
3	333	G.E.	H	1	6900x230/460
3	250	L.M.	OISC	1	14400/13800/240/120
3	200	G.E.	H-K8	1	2400/4160YK120/240

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E.	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/ 4000 V Direct con exciter.
1	1500	Whse.	Auto extraction 190 lbs. — 660° F.T.T. 60 lb. extraction 3/60/240 V. Div. Conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175200# U.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 430/ 3/60.

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	750	G.E.	H	1	4600-120/240
1	750	G.E.	HT	3	4150Y-220/440
2	250	G.E.	H Pyranol	1	2400-4800/6320Y-120/240
2	250	West.		1	2300/4600-230/460
3	200	G.E.	H-KD	1	13800/12420/4600-240/480
3	200	G.E.	H	1	7800/15600-220/440
1	150	Eisler	OA	1	4160-240/480
3	150	West.	S	1	2400/4160-460/230/115
3	50	Niagara	Air Cld	1	2300-120/240
2	50	G.E.	HS	1	2400/4160-240/480
2	37½	West.	Hypersil	1	2400/4160-240/480
6	15	Maloney	KL	1	2400/4160Y-120/240
1	1500	Maloney	ASPL Askrel	3	2400/4160-480 Power Center.

SYNCHRONOUS MOTORS

Qu	HP	Make	Speed	Type	Volts
1	100	G.E.	900	TS	2300
1	125	G.E.	600	TS	2300
1	125	E.M.	900		4800
1	150	G.E.	1800	TS	220/440
2	150	Allis-Ch.	360		2200
1	150	West.	900		220
1	300	E.M.	720	TEFC	2300
1	500	West.	450	HR	440
1	1000	West.	360	Mill	2300/4150

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	15	G.E.	900	MT-542	440
1	25	G.E.	900	MT-526	440
1	60	G.E.	1800	MT	220
1	60	Ideal	900	AV	220
1	75	G.E.	600	IM	440
3	150	Allis-Ch.	1800	AY RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	1200	M	2400/4150

SQUIRREL CAGE

Qu	HP	Make	Speed	Type	Volts
1	40	Wagner	1750	CP TEFC	220/440
1	25	G.E.	1170	405TEFC	220/440
1	75	G.E.	1800	K-4458	440
1	100	West.	1160	CS	440
1	150	G.E.	720	KT-562	440
2	250	G.E.	1790	K.-T.E.F.C.	2300
1	275	G.E.	1200	KT559RS	2200
2	300	G.E.	1800	K-4150V	new
1	400	Cont.	1200	N8068	2300

MOTOR GENERATOR SETS

Qu	K.W.	Make	Speed	Volts DC	AC
1	30	G.E.	1800	125	220/440 V.
3	60	E.M.	1200	125	220 v. 3yn.
1	150	Cr. Wh.	600	125	220/440
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.B.
1	1000	West.	720	600	2300/4160Y

D.C. 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	75	C.W.	900	WP
1	125	G.E.	1700	RC
2	150	C.W.	900	WP
1	250	Allis Ch.	1750	FBL140BB

A.C. HOIST MOTORS

Qu	HP	Make	Type	Speed	Volts
1	35	G.E.	MTC	585	440
2	300	G.E.	ITC-5017	600	440

"FOR POWER"
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK LONGACRE 3-3211
PHONE NEW JERSEY UNION 7-0200

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—1000 KW—240 volts—150/250# Condensing Auto. Extraction—185#—New 1945
1—1000 KW 480 volts—225# Condensing Auto. Extraction—20#
1— 400 KW—350 volts—400# Condensing Auto. Extraction—20/30# New 1948
1— 300 KW—480 volts—210# Condensing Auto. Extraction—45#
1— 250 KW—240 volts—150#—Non-Cond. 10/12# Back pressure

TRANSFORMERS

1—500 KVA 4160/480 V. Pyrenol. 3 ph.
3—500 KVA 2500/550 Volts (New 1948)
1—450 KVA—13,800/208 Volts—3 ph.—(network)

AIRFOIL F-D FANS. UNUSED.

2—50,000 CFM of air at 80° F against static pressure of 9.5" w.g.

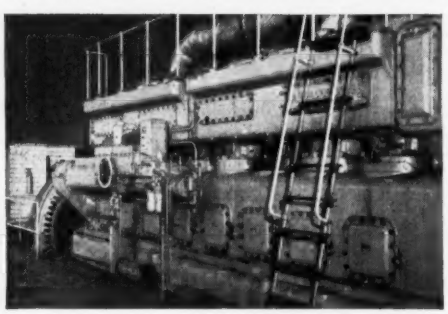
A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass:

THE BUYERS MUST BE SATISFIED—ALWAYS

MODERN SLOW SPEED
DIESEL ELECTRIC GENERATING SET

OFFERED AT CONSIDERABLE SAVING

ALSO AVAILABLE
•
WORTHINGTON
BB5
100 KW
600 RPM
3/60/480
•
Other Sets from 20 KW to 1200 KW

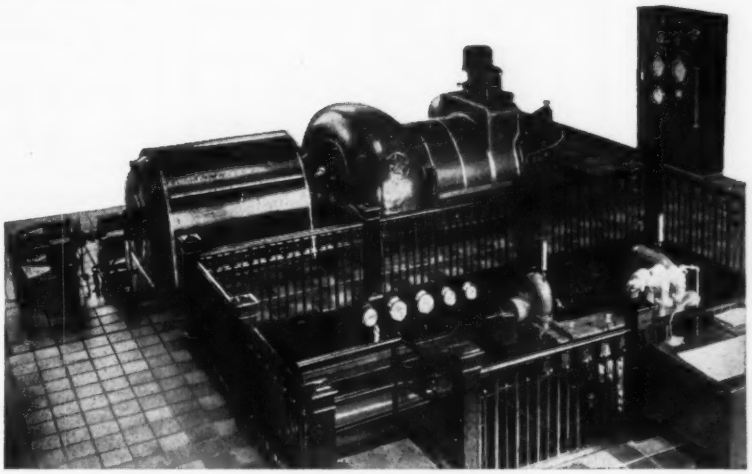


COMPLETE WITH ALL AUXILIARIES
—
Other Sets from 20 KW to 1200 KW

FAIRBANKS MORSE MODEL 33E16
1125 KW 300 RPM 3/60/480V

NATIONAL METAL & STEEL CORP.
1251 NEW DOCK STREET, TERMINAL ISLAND (LOS ANGELES HARBOR), CALIF.
CALL LOS ANGELES NEvada 6-9871
DIESEL DIVISION

MODERN 400 LB., 750 DEG. TURBINE-GENERATOR:



The above G. E. 3750 KVA, 400#, 750 Deg. F. unit in excellent condition, complete. Generator 3/60/2300/4160 V. WE ALSO HAVE IN STOCK: 1—3125 KVA Worthington, 250/300# PSIG (good for 400# with changes), 750 Deg. F. Automatic Extraction 50#, Condensing, 3/60/13,800 V.

CHARLES WEAVER

19701 James Couzens Hwy. **Tel: BRoadway 3-1901** **Detroit 35, Michigan**

TURBO-GENERATORS

2500 KW G.E. Non-C. 3/60/2400/4160 V 3600 RPM 185 PSIG 30# BP

2000 KW Allis, Cond. 3/60/2400 V. 3600 RPM 400 PSIG 600# TT

300 KW G.E. Non-C., 3/60/480 V 3600 RPM 150 PSIG 5# B.P.

Full line power equipment

BREW, WOLTMAN & CO., INC.

50 Church St., New York 7, New York

TRANSFORMERS

BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.
Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

THE ELECTRIC SERVICE CO., INC.

5318 Hetzel St. Cincinnati 27, Ohio

40 Years' Dependable Service

POWER EQUIPMENT FOR SALE

1—Riley BO High Pressure Boiler, 60,000 lbs. per hr., steel clad, age 1949.
1—Cochran Deaerating Heater, 150,000 lbs. per hr., age 1944
1—G.E. Steam Turbo Generator, 500 KW, 2300 volts, non-condensing, generator and exciter.
1—G.E. Steam Turbo Generator, 1000 KW, 2300 volts, extraction condensing type generator and exciter.
1—G.E. Steam Turbo Generator, 1000 KW, 2300 volts, non-condensing type, generator and exciter.
1—West. Steam Turbo Generator, 1250 KW, 600 volts, condensing type, generator and exciter.
1—West. Steam Turbo Generator, 940 KW, 600 volts, condensing type, generator and exciter.
1—West. Steam Turbo Generator, 50 KW, 125 volts, generator and exciter.
6—Maloney Electric Dry Type Transformers, 37½ KVA, type BDC-60 cycles, 2200-600 volts, single phase.

REPUBLIC TEXTILE EQUIPMENT CO.
40 Worth St., N.Y. 15, N.Y. Tel. COrtlandt 7-1591

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FOSTER *QUALITY* **RELAYING RAILS**

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Handle more cars better—cost less to install and maintain. Foster stocks all Rail Sections 12# thru 175#, Switch Material and Track Accessories.

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L.B. FOSTER CO.

PITTSBURGH 30 • NEW YORK 7 • CHICAGO 4
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FOR SALE

DIESEL POWER PLANTS

2—Chicago Pneumatic, 6 cyl. Diesel Engines, Stationary Type, Circulating Water Cooled. Bore 8" Stroke 10½". Type 68CP, 180 H.P. 600 R.P.M. or 225 H.P. at 720 R.P.M.

1—Buda Diesel, 6 cyl. 1200 R.P.M. Model 8-D.C. 1290. Bore 5⅜" Stroke 6½". Circulating Water Cooled, w/125 K.V.A. A.C. Generator, 3 ph. 60 cyc. 1200 R.P.M. 240 volts, and Exciter. Mounted on steel base.

Price and further info. on request

PHILADELPHIA TRANSFORMER CO.

BOX 566

DALTON, PA.

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	2300	Whse.	900
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
250	2300/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	440/220	Whse.	720
150	2200/440	G.E.	600
125	2200	G.E.	600
100	440/220	G.E.	720

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	440/220	G.E.	ATI	600
150	440/220	G.E.	TS	720
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2200/4000	Elliott	SC	1800
350	2200	G.E.	IM	600
350	440	G.E.	KT	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
250	440/220	G.E.	KT	720
250	2300	Whse.	CS	600
200	440/229	G.E.	KT	1800
200	2200	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	440/220	G.E.	KT	720
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200

A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—360 kva, 900 rpm, 2200 V., Whse.
1—225 kva, 60 rpm., 220/440 V., G.E.
1—187 kva., 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V, G.E.
1—400 Amp., Condit, 3P, 25 KV outdoor
1—400 Amp., B. Smith, 3P 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1800
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	850

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
150	Whse.	440/220	Sq. Ca.	275
125	G.E.	4000/440	Syn.	125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph. New
1— 600 kva Standard, 13,800—2300 V., 3 ph.
3— 500 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 2400—480 V.
2— 300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3— 200 kva, G.E., 2400—120/240 V.
3— 200 kva, Mol., 13,800—2300 V
3— 150 kva, Al. Ch. 2400—220 V.
3— 150 kva, Al. Ch., 440-220 V., dry, New
2— 100 kva, G.E., 2400—240/480, V New
3— 75 kva, Whse., 2400—240/480 V.

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Telephone: MUrray Hill 2-8562

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2000 HP 10 cylinder, O.P. model #38E 8 1/8, 800 rpm, modern unit.

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FOR SALE—IMMEDIATE DELIVERY

400 KW Terry non-condensing turbine, 325-400# PSI, 110-125# gauge back pressure, 3800 RPM, direct connected through reduction gear to a:

500 KVA—400 KW at 80% P.F., Allis Chalmers generator, 3 phase 60 cycle, 480 volts, 1200 RPM, excellent condition, complete installation equipped with direct connected exciter, switchboard with instruments and spare parts.

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3 NEW BOILERS

Available at fraction of new cost

BABCOCK & WILCOX single uptake controlled superheat marine type express boilers, 3 drums, with economizers.

Designed pressure	634 lbs.	Steam temperature	850°F
Operating pressure	550 lbs.	Furnace volume	1473 cu. ft.
Superheated steam	221,000 lbs./hr.	Total generating surface	9338 sq. ft.
Saturated steam	32,000 lbs./hr.	Superheater surface	1620 sq. ft.
Full power total	253,000 lbs./hr.	Economizer surface	3843 sq. ft.

NOTE: These boilers are new and complete. They are erected and ready for use and should therefore be considered only for such places as can be reached by water transportation.

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400 h.p. (at 300) ATLAS Imperial 13 x 16 engine (2000 hours) stored in heated building complete in good order. NEW Murphy diesel M.E. 90 4 cyl. 5⅝ x 6½ full load RPM 1200 twin disc coupling 3 to 1. Also excellent dragger HULL 97 x 21 x 10.7 fully equipped less main engine priced right.

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80000#/HR. BOILER
ERIE CITY Type 1-W-T BENT WATER TUBE 3 drum 250 PSI W.P.; Built 1948; 8100 sq. ft. heating surface; 1370 sq. ft. water wall surface; steel encased; Rotograte spreader stoker; forced and induced draft fans; dust collectors; Thermix stack. Used only 2 years.

75000#/HR. BOILER
COMBUSTION ENGR. CO. 4 drum STIRLING Type BOILER 400 PSI W.P.; pulverized coal fired; forced and induced draft fans; superheater, waterwalls.

OTHER SPECIALS
40,000 LB. RILEY, 260 PSI
5000 KVA TURBO GENERATOR, cond, 450 PSI
200 KW MG SET, 250 Volts DC 2300/3/60
6370 sq. ft. CONDENSER
700 HP Synch. MOTOR 4150/2400V, 514 RPM
100 HP Synch. MOTOR 3/60/2300V, 1200 RPM

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Murray Hill 7-5280
(Machinery & Equipment Merchants)

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Fully complete—Cond. like new.

Price and further inf. upon request.

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It's your guarantee that the equipment you buy is as perfect in workmanship as the day it left the factory.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
200	Cr. Wh. b.b. (2)	CMC 81H	230	1150
75	G.E. b.b.	CD-115	230	1150
175	Cr. Wh.	151-H	230	500
150	Whse.	SK-184	230	850
100	Reliance	651-T	550	1000/1600
100	Reliance	651-T	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
60	G.E.	CD-113	230	1150
75	Gen. Elec.	RF-16	230	450/900
75	F. Morse b.b.	DH-140	115	1600
60	G.E. TEFC b.b.	CD-135	230	1150
50	Gen. Elec.	CD-95	230	1800
50	Star b.b.	SQ-92	230	680
50	G.E. (3)	CD-125	230	400/1200
20	Whse. (2)	SK-151	230	250/1000
40	G.E. (2)	CD-93	230	1750

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
300	Whse.*	2200/440 AC	600 DC
200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.	2300 AC	250 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	G.E.*	2200/440 AC	125 DC
100	Whse.	220/440 AC	250 DC
75	G.E. converter	440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Whse.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC
35	Gen. Elec.	220/440 AC	125/250 DC
250	Cr. Wh.*	2300/4000 AC	250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
175	Cr. Wh. b.b.	CCD	250	1450
75	Century	R-92	250	900
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	850
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	F. Morse b.b.	DG	125	1800
60	Allis Ch. (3)	E-146	250	1500

TRANSFORMERS—6—167KVA Allis Ch. dry type, 1 ph. 60 cy. 2400/4160—240/480V., like new.

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
400	G.E. (2)	Slipring	440	900
600	G.E.	Slipring	2200	600
500	Whse.	Slipring	2200	450
450	Allis Ch.	Synch.	480	400
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
350	G.E.	Sq. Cage	2200	1800
350	Cont. b.b.	Slipring	2200	900
300	El. Mchy	Synch.	2200/440	380
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	440	450
300	Allis Ch.	Sq. Cage	2200/440	720
250	G.E.	Slipring	440	1800
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Gen. Elec.	Synch.	220/440	450
250	Whse.	Slipring	440	1200
250	G.E.	Sq. Cage	2200	1800
250	Allis Ch.	Synch.	440	360
225	G.E.	Synch.	2200/440	900
200	G.E. (2)	Sq. Cage	2200/440	1200
200	Whse. (2)	Slipring	2200	514
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
400	Allis Ch.	Sq. Cage	2300	900
175	G.E. (2)	Synch.	220/440	720
150	U.S. b.b.	Sq. Cage	220/440	1800
150	El. Machy.	Synch.	220/440	360
150	G.E. (4)	Slipring	2200/440	600
150	G.E. (2)	Sq. Cage	2200/440	720
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E.	Slip Ring	220/440	450
125	Whse. TEFC	Sq. Cage	2200/440	720
125	G.E. TEFC	Sq. Cage	2200	3600
125	Ideal	Slipring	4000/2200	900
350	Allis Ch.	Slipring	2200/400	600
100	Whse (2)	Sq. Cage	2200	900
200	G.E.	Sq. Cage	440	600

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5000 KW Initial Pres. 450#, RPM 2400, 7150 KVA, 13,800 Volts, 40 Cycles, Rpm 2400, 1948.

2 STEAM GENERATING BOILERS
Combustion Engineering Cap. 60,000 Lbs./Hrs. Heating Surface 7,095 sq. ft. Water Walls 840, Maximum Pressure 440 PSI.

6 MOTOR GENERATOR SETS

No.	KW	Make	Input V. AC	Motor Type	Output V. DC
1	60	GE	550	sq. ca.	125
1	65	GE	550	sq. ca.	125
1	100	GE	550	sq. ca.	125
2	40	GE	550	sq. ca.	125
1	150	GE	550	syn.	125

No.	Make	Type	Speed	Volts	H.P.	Phase	Cycle
18	GE	L	600- 900	550	125	3	40
24	GE	L	600-9000	550	175	3	40

WOOD-AYER REALTY CO.
320 MERRIMAC ST. **LAWRENCE, MASS.**

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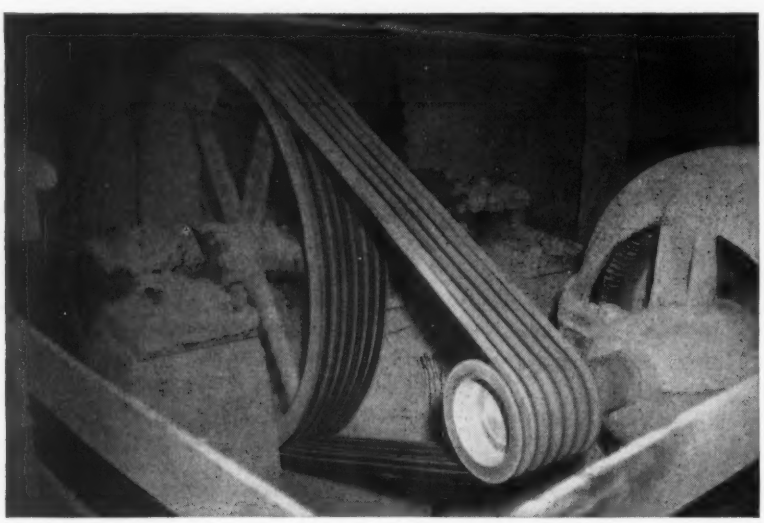
B. F. Goodrich distributors solved these costly problems—can they help you?

Rubber "mule" saves $1500. The circular saws in this lumber mill used to be run by a gear mechanism. But the steel gears wore out too soon, took high overtime to repair and replace. A mule drive, using a B. F. Goodrich Highflex transmission belt, was suggested by a distributor. The change saved $1500 maintenance costs in the first month alone.

Saves cost of freight elevator. Problem in this warehouse was moving refrigerators upstairs for storage, then down again for shipment. A $19,000 freight elevator seemed to be the only answer until a distributor suggested a B. F. Goodrich Ribflex conveyor belt. While it cost much less, the "rubber elevator" works so well, it's giving everything the owners expected in the way of service.



Belt costs cut $100 a month. Six ordinary V belts weren't strong enough to turn a ball mill loaded with 22 tons of steel balls, water and ore. The belts lasted only 5 or 6 weeks. But there wasn't space to expand, and redesigning the drive would cost $800. Then B. F. Goodrich Grommet V belts were tried. They lasted not six weeks but six months, saved $100 a month in belt costs, plus the cost of rebuilding the drive.

These savings were made because a B. F. Goodrich distributor studied the problem, then selected the type, size and grade of belt that was right for the job.

If you have "problem" installations in your plant, remember that B. F. Goodrich distributors are "specialists in rubber", ready to put their training and experience to work for you. By making a B. F. Goodrich distributor your *chief* supplier for rubber products, you not only get top quality products, but you also save buying time, have a dependable source of supply, and get fast delivery on most items from local stocks. *B. F. Goodrich Industrial Products Co., Dept. M-885, Akron 18, Ohio.*

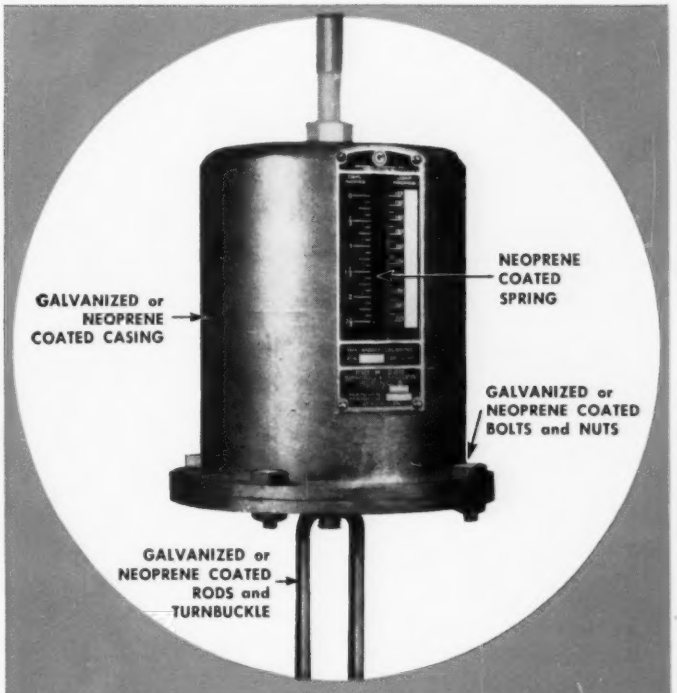
Grommet—T. M. The B. F. Goodrich Co.

B.F.Goodrich

INDUSTRIAL PRODUCTS

NEW

weather-resistant, corrosion-resistant GRINNELL VARIABLE SPRING HANGERS...


GALVANIZED or NEOPRENE COATED CASING
NEOPRENE COATED SPRING
GALVANIZED or NEOPRENE COATED BOLTS and NUTS
GALVANIZED or NEOPRENE COATED RODS and TURNBUCKLE

Another Grinnell First!

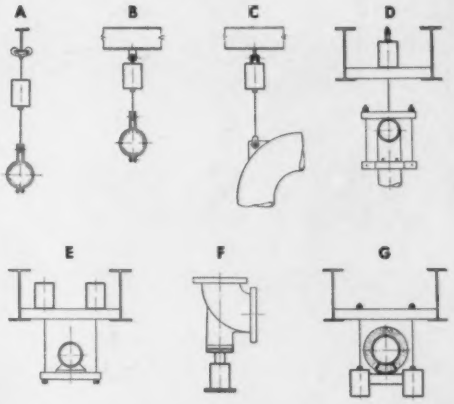
Grinnell pre-engineered spring hangers are now offered in two new lines to meet the need for spring hangers in installations subject to highly corrosive industrial conditions and to severe weather exposure.

These hangers are the result of extensive experimentation with various coatings for Grinnell's standard pre-engineered spring hangers. In addition to providing flexibility in pipe suspension, they provide versatility of application through their corrosion-resistant characteristics. They are . . .

1. Neoprene coated—for highly corrosive conditions such as those found in chemical plants and refineries. *All* parts of the hanger are neoprene coated to protect the base metal from a wide range of corrosives. The flex life of the spring is unaffected by the neoprene . . . the coating resists cracking or flaking over a wide temperature range.

2. Galvanized—for outdoor installations where weather conditions are severe. All parts of the hanger are galvanized except the spring, which is neoprene coated to avoid alteration of temper, hydrogen embrittlement and decreased flex-life of the spring—usual hazards to springs from the galvanizing process.

AVAILABLE IN 7 TYPES FOR THESE TYPICAL APPLICATIONS



(A) Rod threaded to top cap (B) Furnished with single lug (C) Two lug style (D) Top adjusting (E) Adjustable top and bottom (F) For floor support (G) Trapeze assembly.

Along with the obvious advantages of such corrosion and weather-resistant characteristics, consider these features...

- Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression* assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.
- 18 sizes available from stock for load ranges from 53 lbs. to 12,000 lbs.
- Available in 3 spring lengths for travel ranges of 1¼, 2½, and 5 inches.
- Installation is simplified by integral load scale and travel indicators.

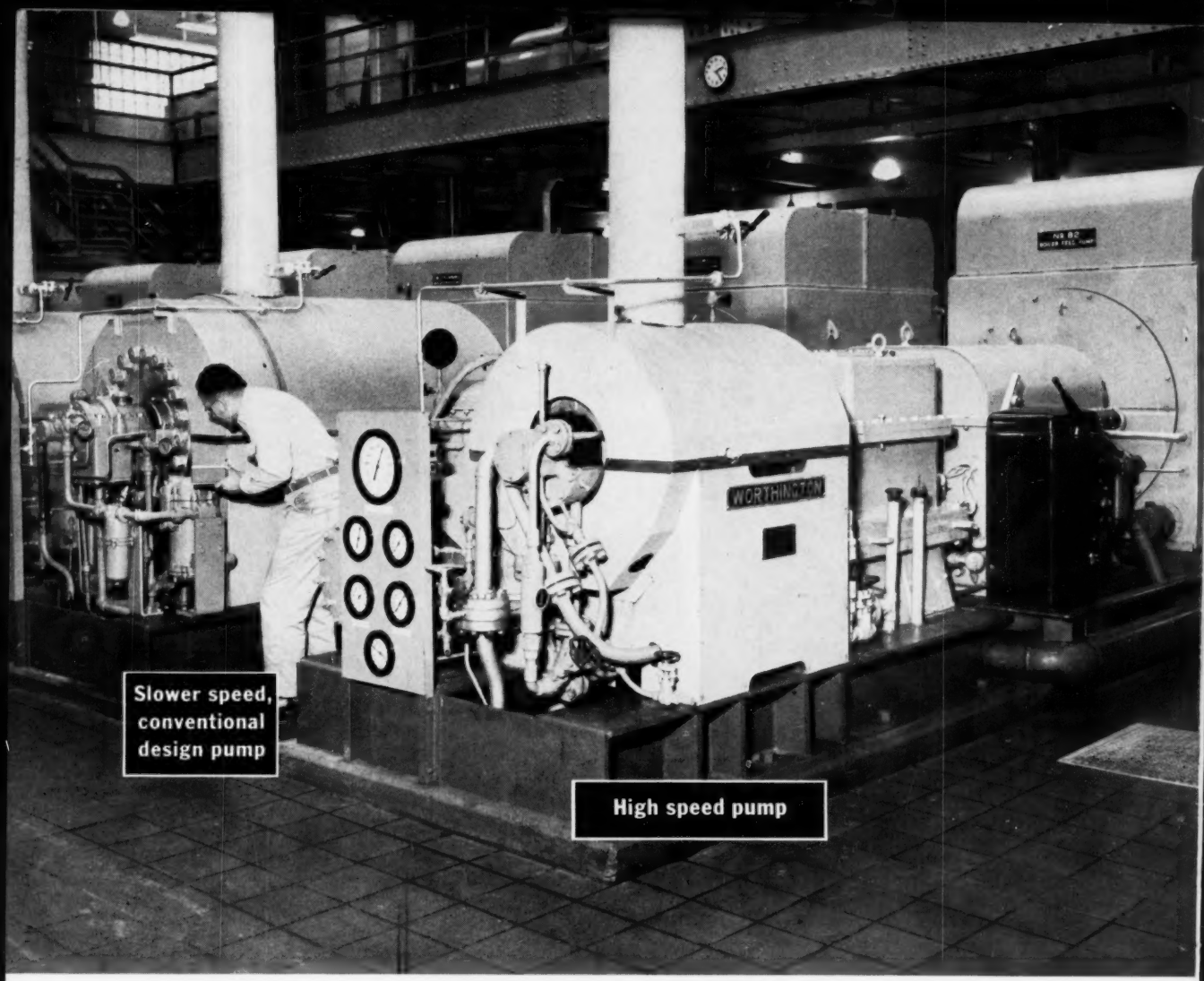
Precompression is a patented feature.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



6,000..8,000..10,000 rpm?

How much speed for modern boiler feed pumps?

With the trend towards superpressure power plants, a new look is being taken at existing boiler feed pump designs.

It's apparent that pressures as high as 5,000 psi cannot be reached economically at conventional speeds of 3,600 rpm without sacrificing reliability.

The 9,000 rpm Worthington pump above breaks through the speed barrier. Alongside a conventional unit with duplicate pressure and capacity ratings, its smaller size is dramatically evident. And this means greater reliability, lower costs. In operation since 1954, it has given satisfactory and reliable service in the new Kearny Generating Station of Public Service Electric and Gas Company, Kearny, N. J.

Twenty-two more Worthington high speed pumps on order. Speeds range from 6,500 to 9,000 rpm. If necessary, Worthington sees no reason why operating speeds shouldn't go even higher, without departing from experience-proved construction principles.

For more information, get in touch with your nearest Worthington District Office. If you'd like a copy of Bulletin RP-703, an interesting discussion of "High Speed Feed Pumps For Superpressures," write to Section C65, Worthington Corporation, Harrison, N. J. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ont. C-6.5

WORTHINGTON